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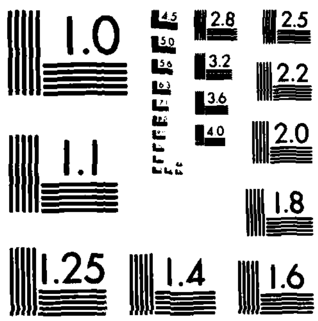

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US Army Corps
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AD-A150 318

User Manual

Regional Development Impacts Multi - Regional Multi - Industry Model (MRMI)

User Manual 84-UM-2

September 1982

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The overall objective of this user manual is to describe a modeling methodology for estimating regional development impacts associated with U.S. Army Corps of Engineers water resource projects. The manual is intended to serve as a self-contained reference source for understanding the theoretical basis for MRMI, its technical structure and the procedures for generating regional forecasts. The MRMI model was developed by Professor Harris, University of Maryland. It is implemented by Urban Systems Research and Engineering, Inc. for commercial applications. The model gives enourmous flexibility in capturing industries or

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20. geographic detail, since it is based on county level data base and over industry sectors.

THE MULTIREGIONAL MULTI-INDUSTRY (MRMI) MODEL OF THE U.S. ECONOMY: USER MANUAL FOR EVALUATING REGIONAL DEVELOPMENT IMPACTS OF WATER RESOURCE PROJECTS

Prepared for:

U.S. Army Corps of Engineers
Institute of Water Resources
Fort Belvoir, Virginia

Prepared by:

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September 9, 1982

FOREWORD

This user manual is a product of IWR's Regional Economic Development Impact research work unit. It continues the methodological work begun in the Corps Appalachian Water Resources Survey and continued in the IWR-SWD research on Regional Impacts of the completed McClellen-Kerr Arkansas River Navigation Project. The purpose of regional economic development impact models is to estimate jobs, personal income and industrial output which would be due to implementation of a Corps water resource project. A fundamental attribute of these models is that they are evaluating the impacts of lowered delivered costs due to transportion savings, the expenditure stream generated by recreational users, or the expenditures associated with project construction and operation. Therefore, they are dependant on the data generated for user benefits as inputs. This linkage provides a logically consistent evaluation process.

The IWR models provide for regional accounts encompassing the United States and for as many as 100 sectors of each regional economy. Normally, division of the nation into 3 or 4 regions provides adequate regional detail. Depending on the project, about 10-30 sectors usually provides adequate sector detail. The region/sector configuration is the most important decision to be made early in the regional economic development analysis, since it also defines the required organization of input data. An overall regional input assessment manual under preparation, will present additional information on this issue. Meanwhile, each user manual contains a discussion of this issue from the model developers perspective.

Changes in income, output and employment are not necessarily national economic development benefits. Because, continuous full employment is assumed to be given in the NED analysis, user benefits (willingness to pay for project output) is the logical measure used for NED evaluation. Therefore, the estimates of changes in output, income and employment by region should be used solely in the regional economic development account.

Many economists have participated in the development and testing of these models. Corps economists from the Southwestern Division, South Atlantic Division and Lower Mississippi River Division have invested their time and skill in honing the design and evaluating tests conducted on Corps projects. Ed Cohn and Bob Daniel, as chief of the Economic and Social Analysis Branch, Planning Division, Office of the Chief of Engineers, invested their skill and energy as technical monitors to guide the developmentof these models. Finally, Dr. Neil Dikeman of the University of Oklahoma's Bureau of Business and Management Research and his staff provided splendid editorial and research coordination services to the model/user manual developers:

Multiregional variable Input-Output Model and User Manual.

Dr. Chong and Dr. Chung Liew, University of Oklahoma.

Multi-Regional - Multi-Industry Model User Manual.

Dr. Peter Hall, Urban System Research and Engineering Co. Inc., Washington, D.C.

Linear Programming-Economic Base Model and User Manual.

Dr. W. Chris Lewis and Dr. Terry Glover, Lewis Associates and Utah State University.

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CHAPTER 1

OBJECTIVES AND OUTLINE OF THE USER MANUAL

1.1 Objectives

The overall objective of this User Manual is to describe a modeling methodology for estimating regional development impacts associated with U.S. Army Corps of Engineers water resource projects. The manual concerns the Multiregional Multi-Industry (MRMI) forecasting model, a large-scale econometric framework that forecasts economic and demographic activity in areas as small as counties. The User Manual is intended to serve as a self-contained reference source for understanding the theoretical basis for MRMI, its technical structure and the procedures for generating regional forecasts. More importantly, it details the data development activities that are required to estimate direct impacts associated with Corps projects and to incorporate these impacts into the model's data base. Considerations regarding consistency between estimated direct impacts and MRMI's internal data conventions are also raised.

The User Manual uses the Coosa River Navigation Project as a case study for illustrating the process of estimating direct impacts. This project, proposed for the Coosa River between Montgomery and Gadsden, Albama, is excellent case study material, for it considers a wide variety of direct impacts, ranging from construction and equipment expenditures during the construction phase, to transportation cost savings, revenue changes in competing transportation modes and revenue losses to an electric utility during the operational phase of the project. Several products for interpreting model results, developed for the Coosa River evaluation, are reviewed in the manual.

The advantages of using MRMI for project evaluation are many. First, as the model characterizes regional economies in a multi-regional framework, MRMI produces a set of consistent regional forecasts for estimating project impacts. Second, the model is comprehensive; the MRMI data base encompasses economic and demographic data for all regions of the United States, ie. for 3,103 counties or 585 Standard Metropolitan Statistical Areas (SMSAs) and non-SMSA portions of BEA economic areas. Third, the model is extremely detailed; MRMI estimates output, employment, payrolls, personal consumption expenditures, defense expenditures, imports and exports for 104 industry sectors. Equipment expenditures are projected for 73 sectors and construction expenditures comprise 26 sectors. Numerous other economic indicators, described in Chapter 2, are estimated as well. Finally, MRMI is flexible, as it can incorporate alternative macroeconomic, national inter-industry and regional impact scenarios. Clearly, the MRMI modeling framework affords the analyst a highly sophisticated and consistent forecasting tool for estimating regional development impacts.

1.2 Outline for the User Manual

This User Manual consists of four major topic areas which are conveniently divided into three chapters and an appendix. (Two other appendices provide background information only). Chapter 2 is devoted mainly to describing the MRMI model. Here, the theortical basis for the model is discussed and a general outline of its major components is given. Readers not familiar or interested in the theoretical aspects of MRMI may skip this section and proceed to the general outline of the model without sacrificing their understanding of how the model works. The general description includes the major operating features of the model, the variables it forecasts and data sources for estimating its coefficients. The chapter also includes a brief description of how direct impacts are incorporated into regional forecasts in order to estimate their multiregional indirect and induced consequences.

Chapter 3 describes in detail the data development activities that are required to estimate regional development impacts. The chapter discusses scenario development in both national and regional economic contexts and data sources for estimating macroeconomic and direct impacts data. Considerations for ensuring consistency between exogenously estimated data and MRMI's internal data structure are outlined as are issues in defining appropriate impact regions for analysis.

Chapter 4 is devoted to model execution and the interpretation of its output. As MRMI forecasts are based upon macroeconomic, national inter-industry and regional projections, the model must be executed in stages. The sequencing of these stages is discussed in some detail to enable the analyst to appreciate the activities involved in producing regional economic forecasts. The structure of MRMI's output is also identified and programming aids for analyzing regional forecasts and regional development impacts are described.

Appendix I contains a case study application of MRMI on the Coosa River Navigation Project. This study, commissed by the Corps., illustrates how macroeconomic and direct impacts data are estimated in a real planning application. The appendix comprises a general overview of the project to give the data development sections an appropriate context, and the procedures that were undertaken to produce regional baseline and impact projections. Readers should refer to this appendix as they proceed through the main body of the User Manual.

The two other appendicies are included in the User Manual for reference purposes. Appendix II is a glossary which defines the fundamental economic and demographic terms in MRMI. This appendix should be referenced if either the terminology in the text of the manual is not clear (if the exact definition of the term "output", as defined for modeling purposes, is not known, for example) or consistency issues arise when developing direct impacts data. Appendix III is supporting documentation for direct impacts estimation procedures used in the Coosa River Navigation Study (Appendix I) and serves no direct purpose for the User Manual, itself. Another appendix, Appendix IV, comprises a Training Manual for a course on evaluating Corps waterway projects using MRMI. References to data and other information are provided in footnotes to the main text of the report.

CHAPTER 2

INTRODUCTION TO LOCATION THEORY AND THE MULTIREGIONAL MULTI-INDUSTRY (MRMI) MODEL

When estimating regional development impacts of large-scale projects, it is important that users of modeling systems understand what the models can deliver and how they produce the results that they do. This chapter is intended to serve this purpose. It first describes the fundamental theoretical basis for the MRMI model before detailing its structure and operating procedures. It also serves to highlight the model's capabilities and to outline the basic inputs required to produce a forecast. General procedures for simulating regional development impacts in the model are also discussed.

2.1 Location Theory and Regional Economic Change

The theoretical basis for MRMI is embodied in the principles of location theory, a branch of economic thought that has been in existence since the early 1800's. Location theory is a theory about where firms survive, and as such makes assumptions about the behavior of society as a whole, rather than merely about the entrepreneur who is making a location decision. Even though theories of location are couched in terms of individual decision making and assume profit maximization, these theories do not have to suppose that locators actually behave in this profit maximization manner, but rather that society's economic pressures create location patterns which appear as if firms located to maximize profits.

Central to the theory is the concept of location rent. In its simplest form location rent is a measure of economic advantage and is directly related to the costs of shipping a producer's goods to the marketplace. Typically, then, locations with higher location rents are those with lower transportation costs to markets and/or to sources of major production inputs. Location theory postulates that location rents result from a bidding process among alternative producers. The land use (producer) that bids highest is the one that can reap the greatest economic advantage from the locational attributes and, as a result, displaces other potential users. Location rent can be considered as a factor payment to landlords because of the land's locational amenities, or as profit if the landlord and production entity are one and the same. The notion of profits exists through the interaction of a demand curve for a good and the location of producers. That is, producers will enter the market until a supply-demand equilibrium exists. But, as land is a finite commodity, producers must locate further and further from the marketplace, incurring greater transportation costs, until the costs of production (including transportation costs) equal the market price. At this marginal location, location rents are zero and a competitive equilibrium between supply and demand exists.

These concepts can be illustrated by a simple example. Consider a market located at the origin in Figure 2-1 for a single good. Producers of the good can locate anywhere along the line represented by the x-axis in the diagram. DD represents a downward

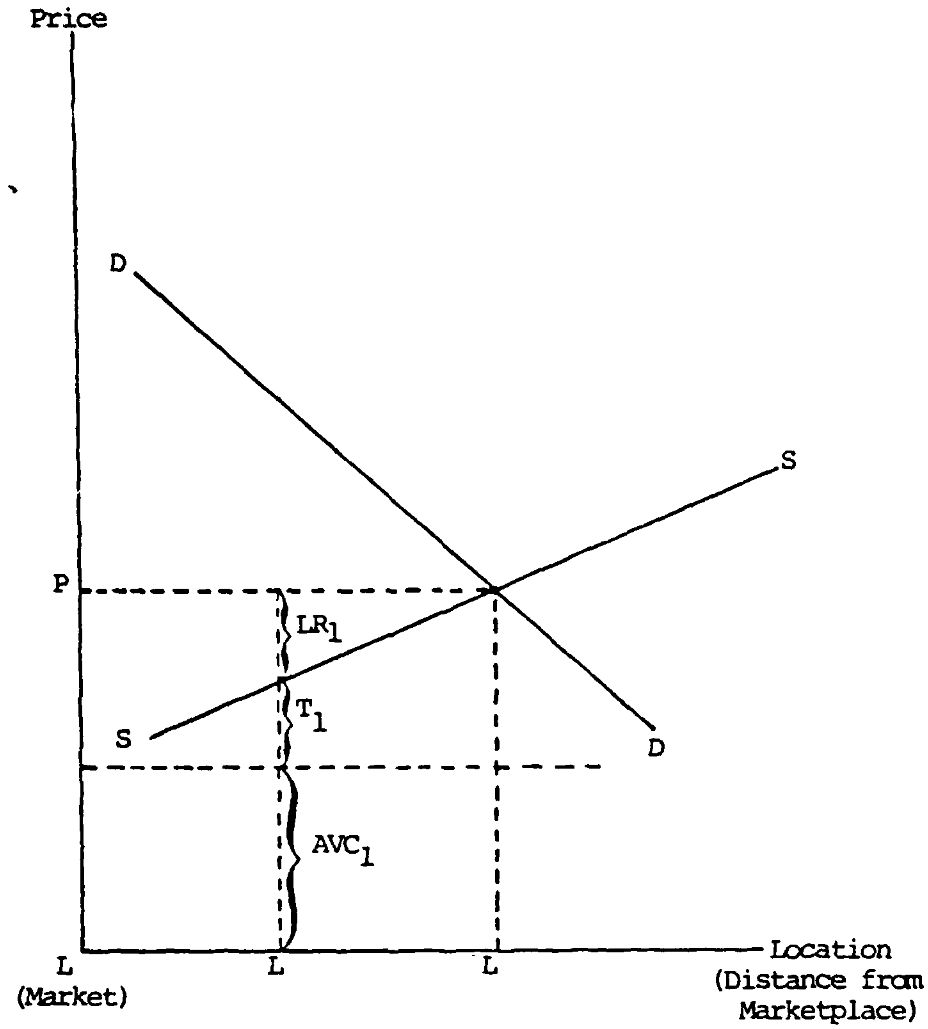

Figure 2-1: LOCATION RENTS AS A FUNCTION OF DISTANCE IN A SINGLE-GOOD MARKET

sloping demand curve with a standard negative price elasticity associated with it. SS denotes the supply of the good to the marketplace, but note that it represents the cumulative supply of the good as distance from the marketplace increases. Costs associated with production are the sum of two components: the average variable cost of producing the good, (AVC) which is assumed to be the same for all firms and the cost of transporting products to the marketplace, T, which increases with distance. In a competitive equilibrium, entry into the market will occur until unit production costs plus shipping equal the price of the good (given a static demand curve). The concept of location rent follows directly as the difference between the price of the good, set at the marginal producing location, L_m, and the average variable costs of production plus shipping costs. Thus, at location L_1, location rent is:

$$LR_1 = P - (AVC_1 + T_1) \qquad (2\text{-}1)$$

Location rents are highest near the marketplace, where shipping costs approach zero and decline monotonically to L_m, the marginal producing location.

We can use this latter observation to illustrate how a competitive bidding process determines the location rent at any given location by introducing a second good into the marketplace having different cost and price characteristics. In Figure 2-2, the location rent surface for the first good is represented by the curve

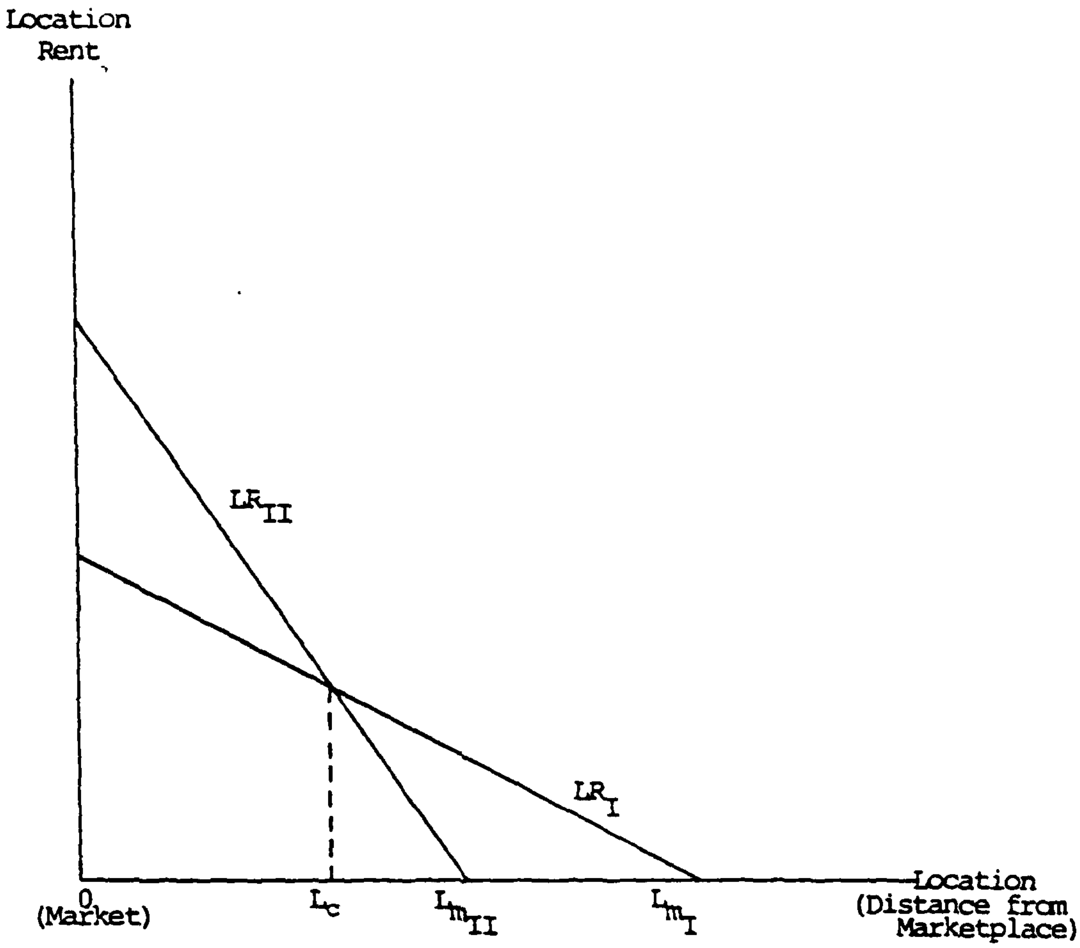

Figure 2-2: LAND USE DETERMINATION FROM LOCATION RENTS ASSOCIATED WITH PRODUCERS OF DIFFERENT GOODS

LR_I and that for the second good by LR_{II}. Because of its particular cost and price characteristics, producers of the second good are able to outbid producers of the first to the point L_c in the figure. Beyond that, location rents associated with the first good are higher. Assuming that landlords are profit maximizers, the location rent curve for the marketplace would be discontinuous, composed of LR_{II} from the L_o to L_c and LR_I from L_c to L_{M_I}. Production of the first good would occur only beyond L_c. In a marketplace with many goods, the location rent surface would obviously become progressively more complex.

In the MRMI model, the concepts relating to location rents are similar, but important differences exist. First, locations in the model are not continuous, but rather, consist of discontinuous regions in which producers may locate. Second, land is not as "finite" a resource as in the example, precluding much of the competition between producers of different goods for land. Third, the quantities of goods produced by different establishments within the same industries are discontinuous, thereby eliminating smooth location rent surfaces. Fourth, factors other than location rent influence the location decisions of producers, distorting "optimal" location patterns further. Finally, the process of adjustment by producers to equilibrium location patterns is constrained by existing plant and equipment; given a change in demand, producers of a good cannot respond instantaneously because of inertia brought about by previous investment decisions.

But the influence of location rent upon the distribution of production among regions is conceptually identical and can be shown by examining the basic structure of the model. Consider a scheme where there are R locations and N communities. Each "location" is characterized by a region, such as a county or economic area, where both producing and consuming activities can take place. At each location producing a commodity, say n, there may be any number of firms, but we are interested in the aggregate production of the commodity in the region and thus consider total regional production to be equivalent to that of a single establishment in the previous example. If we consider the situation for a market located in a region h (Figure 2-3), we see that it is supplied by producers from various producing regions r = (1, 2, ... , 6). As quantities produced by each region are discontinuous, the cumulative supply curve is represented by a step functon. The vertical distance of one step equals the average variable cost at r plus the cost of transporting a unit of commodity from r to h.

As before, location rent per unit of output, LR, is defined as the difference between the market price, P, and the sum of the average variable cost, AVC, and the unit tranport cost, T. Average variable costs include normal returns on investment plus any portion of land rent that is not associated with location (usually agricultural land value). This relationship is characterized by the equation:

$$LR_r = P_h - AVC_r - T_{rh} \tag{2-3}$$

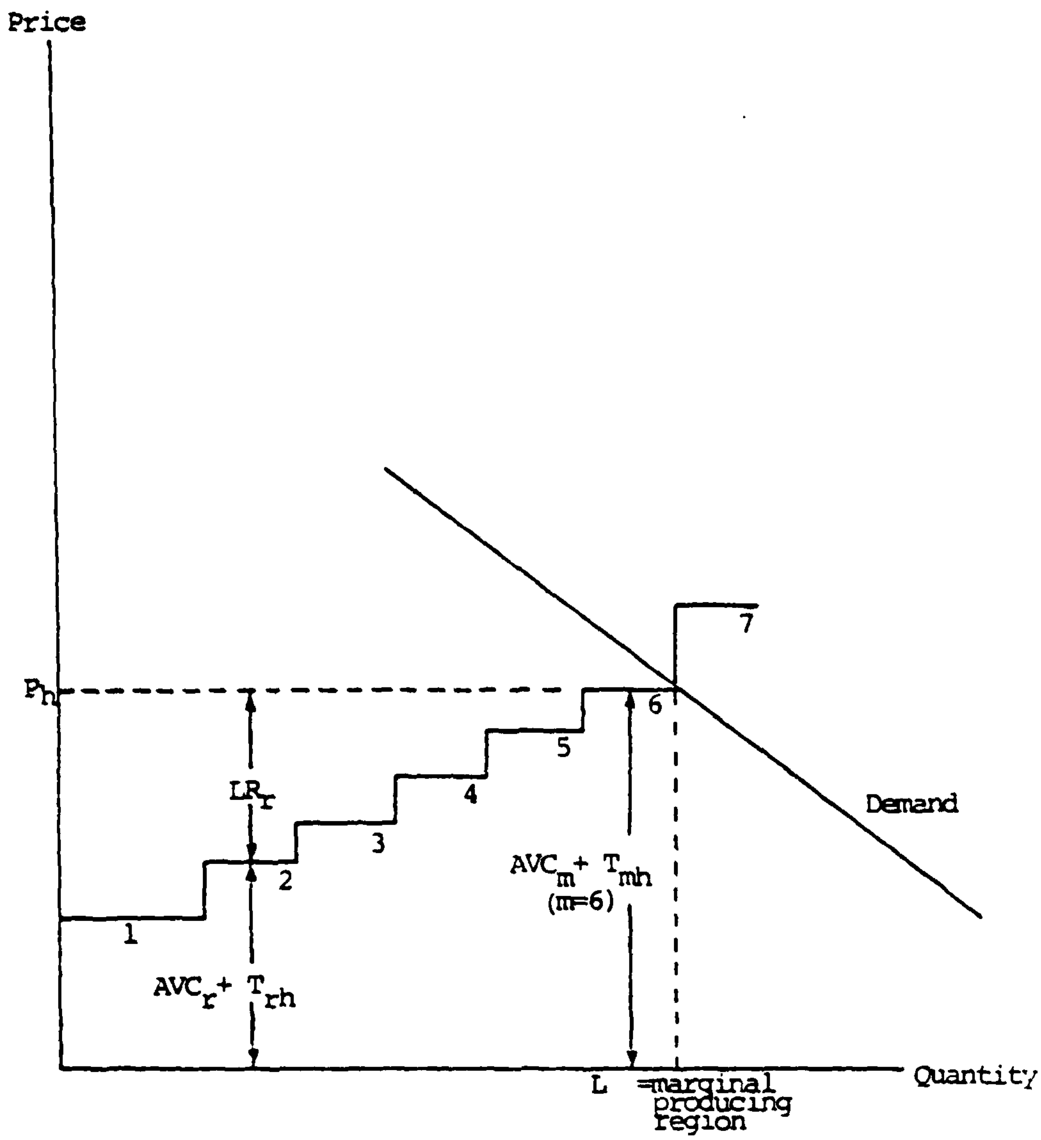

Figure 2-3: QUANTITIES OF COMMODITY j PRODUCED IN REGIONS r =(1,2,...,6) FOR MARKET h AT PRICE P_h (COMMODITY SUBSCRIPT j SUPPRESSED.)

Instead of using price as a variable, however, an identity established earlier, where the price of a commodity is equivalent to the average variable cost plus transport cost at the marginal producing location, m, can be used to develop a fundamental relationship in the model. That is, if

$$P_h = AVC_m + T_{mh} \tag{2-4}$$

then:

$$LR_r = (AVC_m - AVC_r) + (T_{mh} - T_{rh}) \tag{2-5}$$

Location rent is thereby equal to the difference between the average variable costs at the marginal location m and location r plus the difference between transport costs from these regions.

Note from equation (2.3) that location rent can take the form of either profits or as rent payable to landlords, as was discussed earlier. But while they are theoretically equivalent, it is conceptually clearer if we consider the location rent term as profits. Then, the incentives for shifting production from one region to another become apparent. Under the conditions hypothesized in Figure 2-3, individual firms always have the incentive to relocate to regions permitting higher profits, and therefore a locational equilibrium cannot exist. For example, in Figure 2-3, if production in location 6 were to relocate to location 1, the supply curve in market h would shift downward inducing a decrease in the market price <u>and</u> in the profits received by all producing locations (Figure 2-4). In fact, if all firms relocated

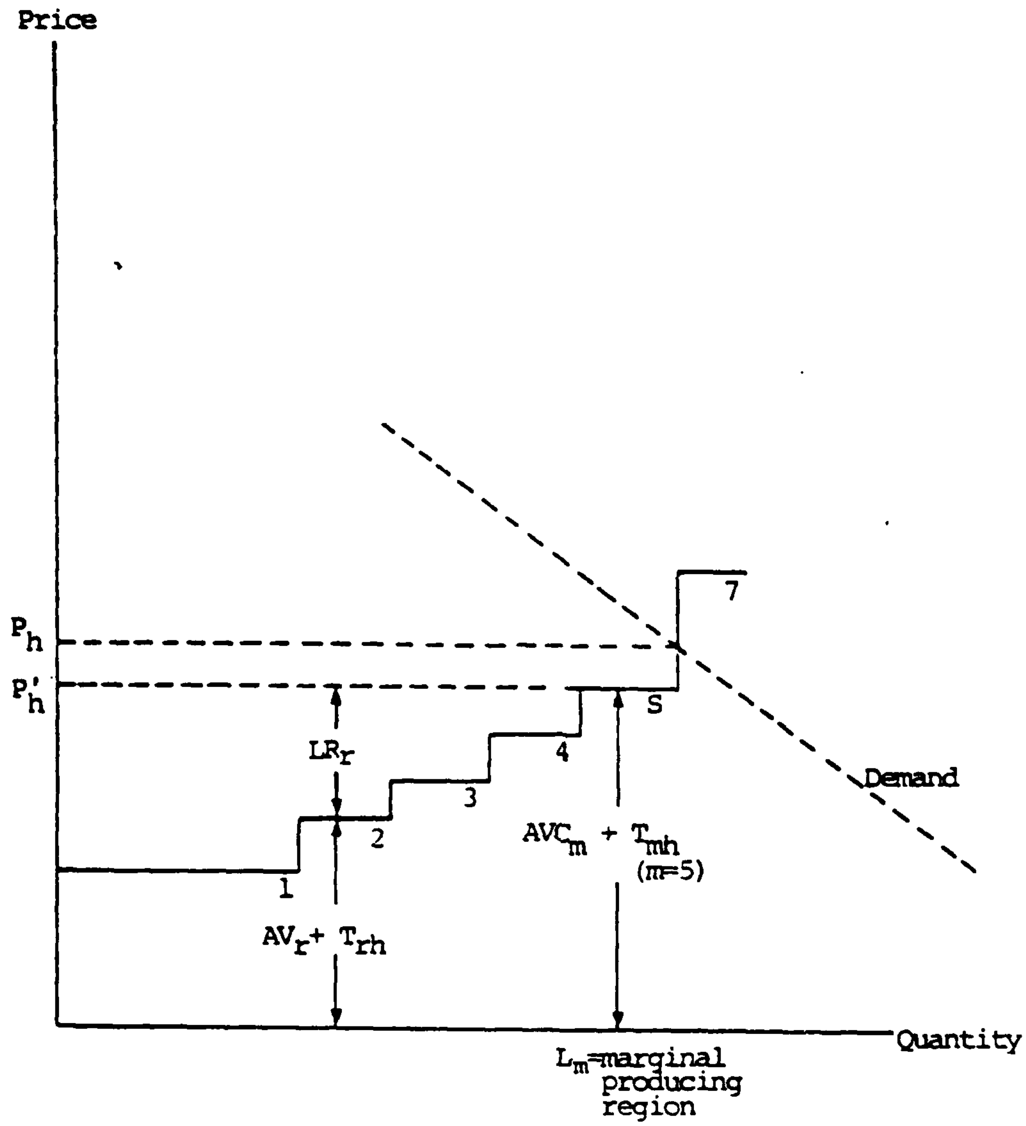

Figure 2-4: CHANGE IN PRICE FOR COMMODITY j AND PROFITS OF PRODUCERS INDUCED BY SHIFT IN PRODUCTION FROM REGION 6 (FORMER MARGINAL PRODUCING REGION) TO REGION 1

to the most favorable location, equilibrium would be achieved and profits would decline to zero.

But this assumes that all other locational factors would remain constant, an assumption that cannot be supported when considering regional economic change. For example, if relocation of the industry from the marginal producing region induced a change in the supply curve for market h, prices would decline causing an increase in demand for the commodity. This would stimulate increased production by existing producers or encourage entry into the market by new producers. Furthermore, increased production would create additional demand for labor and therefore would increase wage rates relative to other locations (changing the average variable cost term for the region). Labor force migration to these areas in response to higher wage rates would also create excess labor demand while in marginal producing regions, wage rates might decrease.

The changes brought about by these adjustments would not stop there, however. The migration of labor to more favorable producing locations would increase the demand for goods and services and thus would increase prices. Furthermore, increased production to satisfy greater consumption demands could increase input prices.

In essence, if production located to more favorable locations in response to location rent alone, the prices of all commodities and inputs would likely change causing location rents to change for all industries in all other regions. There is no way to determine theoretically the net magnitude or direction of these changes since both the supply and demand curves for all commodities and inputs are continuously shifting in different directions.

We can, however, characterize the economic processes taking place if we are willing to alter the way we observe the system, for example, by viewing these processes like we do a series of snapshots or frames in a motion picture. In effect, we are imposing some structure, or order, upon the system which, although it may not precisely mirror the myriad of processes taking place, allows us to organize them into a system of equations for tracking and forecasting regional economic change. In MRMI, structure is imposed by representing locational change as a recursive dynamic process. The series of "snapshots" are fixed intervals of time -- each a single year -- where at the beginning of the period there is a set of profits which vary by location to which industries adjust by relocating. The relocations, however, cause changes in profits which are recognized at the beginning of the next period causing another round of relocations, and so on. How this characterization is transformed into an operational model is the topic of the next section.

2.2 Theoretical Structure of MRMI

The equations that are used to estimate regional economic activity in the U.S. reflect the processes by which major production and household location decisions are made. For example, a firm is motivated by profit and the decisions to change the production level at existing sites or to start production at new locations are related to profit maximization motives. That is, if one location yields higher profits than others, there will be an incentive for the firm to locate there or increase production if the firm is situated at that location. Differences in profitability between regions are a function of differences in production and transportation costs between the regions.

As the location decisions of industries depend on regional differences in production costs, the regional patterns of investment depend on the production decisions. In fact, a firm's decision to build a new plant or increase production capacity in a region is made concurrently with the production decision. That is, the location of industry also determines the locations of investment demand. Therefore, in the MRMI model, regional investment demand is related to the changes in regional production. The location of jobs by place of work is also related to production.

The location decisions of individuals are similar to that of firms. Individuals migrate to regions if the regions have low unemployment rates, high wages, and good employment opportunities. Thus, the MRMI equations that forecast population are formulated to include changes in employment by place of residence, and relative unemployment in the region.

The estimates of regional final demand are derived endogenously, reflecting demand both by consumers and industries. In other words, regional demand is induced by changes in regional production patterns and not vice-versa as in input-output models.

MRMI is composed of four major blocks of equations:

- industry location;
- labor force and demographics;
- final demand; and
- transportation and interregional trade.

The structure of these blocks, their explanatory variables and the interdependencies of their various components are described below.

2.2.1 Industry Location

The principal driving force in the model is a set of industry location equations that explain changes in output by region using independent variables that represent components of profits. The explanatory variables include location rent, the value of land, prior investments in equipment, prior production, and agglomeration variables which are identified as population density, the economic size of major buyers, and the economic size of major suppliers. The agglomeration variables represent external effects on the industry. In addition to transportation and other costs, the proximity of buyers or suppliers and population density are used as independent variables in location equations.

A set of linear regression equations, one for each industry, estimates a region's share of output relative to national output. The general form of these equations is:

$$Q_j^g = f_j \left(R_j^g, VL^g, D_j^g, S_j^g, IS_j^g, EQ_j^g\right)$$

where:

Q_j^g	=	regional share of output relative to national output for industry j in region g
R_j^g	=	location rent for j in region g,
VL^g	=	value of land per acre in region g,
D_j^g	=	total demand for j in region g,
S_j^g	=	prior supply of j in region g,
IS_j^g	=	input scarcity of j in region g,
EQ_j^g	=	gross equipment purchases by j in g.

Variables on the right-hand side of the equation are lagged variables from year t-1. The location rent associated with an industry embodies marginal costs of shipping products, marginal transportation costs of obtaining inputs, and labor costs. Total demand and supply variables proxy for individual buyers and suppliers of an industry's products.

2.2.2 Labor Force and Demographics

Once the location of output is determined and the changes in production are estimated, employment by place of work and by place of residence, labor force, and population are derived in the demographic block of the MRMI model. Changes in the location of production influence the decisions of individuals to migrate and locate in the region. Using this framework, the first set of equations in the demographic component of the model explains changes in jobs by place of employment and by industry in a region as a function of:

- o level of output, and
- o level of capital investment.

Next, total jobs by place of work are adjusted for estimates of net commuters and multi-job holders to derive employment by place of residence.

As previously stated, individuals are assumed to relocate in response to regional labor market conditions. Thus, the MRMI model forecasts population migration by age-race group as a function of:

- o regional wage rates;
- o changes in regional employment; and
- o labor surplus or deficit in the regions.

If a region's unemployment rate is lower than the national rate, then there is a labor surplus in the regional labor market. A surplus in the labor market of a region will induce population to migrate out of the region. Regional population is derived by adjusting prior population by age-race group for natural changes in population and estimates of population migration.

The final set of equations of this block explain regional payrolls by industry and are related to:

- o employment; and
- o capital investment.

Next, regional personal income is derived from payrolls and other components of income.

2.2.3 Final Demand

Total regional demand by industry consists of the following major groups:

- o intermediate demand by other industries;
- o personal consumption expenditures;
- o equipment purchases;
- o construction expenditures;
- o government expenditures; and
- o foreign exports.

Personal consumption expenditures by industry sector and region are formulated to depend on regional personal income. Regional equipment expenditures by industry, and construction are formulated to depend on changes in output and the level of output by industry. Residential and related private construction expenditures, and public construction expenditures are related to regional personal income, while other private construction expenditures are related to output. Government expenditures and exports are derived using either prior estimates of these variables or personal income. Finally, the intermediate demand estimates are derived by applying technical input-output coefficients to the estimates of regional output.

2.2.4 Transportation and Interregional Trade

An important feature of MRMI which distinguishes it from most regional models is its ability to recognize the multiple interdependencies among regions. These interdependencies are characterizied by transportation variables which are input to regional location equations. Costs of shipping a marginal unit of production both to and from each region are determined from the solution to a linear programming transportation problem and reflect the comparative advantages of the county or SMSA/economic area with respect to surrounding areas. In this way, the competitive economic structure among regions is recognized.

The transportation sub-model in MRMI is a classical transportation problem where the total cost of transporting a commodity between producing regions and market regions is minimized. Each region's production of a commodity is limited by its production capacity and shipments of each commodity to each region (including shipments within the region) are constrained by that region's demand. The LP submodel requires a set of inputs which include transportation rates for shipping each commodity between any pair of producing and market regions. It also requires total interregional exports and imports of each commodity. The exports constrain the total shipments out of a region while imports limit the shipments into a region.

The outputs of the submodel include optimum shipments of commodities among regions (regional demand and supply) in addition to shadow prices--marginal transportation costs of shipping commodities into and out of each region.

2.2.5 Synthesis

Although the internal detail of MRMI is in four separate blocks, the model operates in a single framework with many interdependencies and linkages among its various components. A simple schematic design showing the interdependencies of the four components is presented in Figure 2-5.

Within this framework, MRMI develops detailed projections of economic and demographic activity. The model estimates output, employment, earnings, personal consumption expenditures, defense expenditures, exports and imports for 104 industrial categories. In addition, expenditures on equipment are reported for 73 equipment purchasing sectors which either correspond directly to the above industrial categories or are some combination of them. Construction expenditures are estimated for 26 construction sectors, and 24 general government sectors are used to report data on government expenditures, including construction expenditures and employee compensation. Demographic statistics for four age and two race cohorts are also estimated for each forecast year. Other variables that are projected include personal income, transfer payments, in-commuters and civilian unemployment. Sectors and

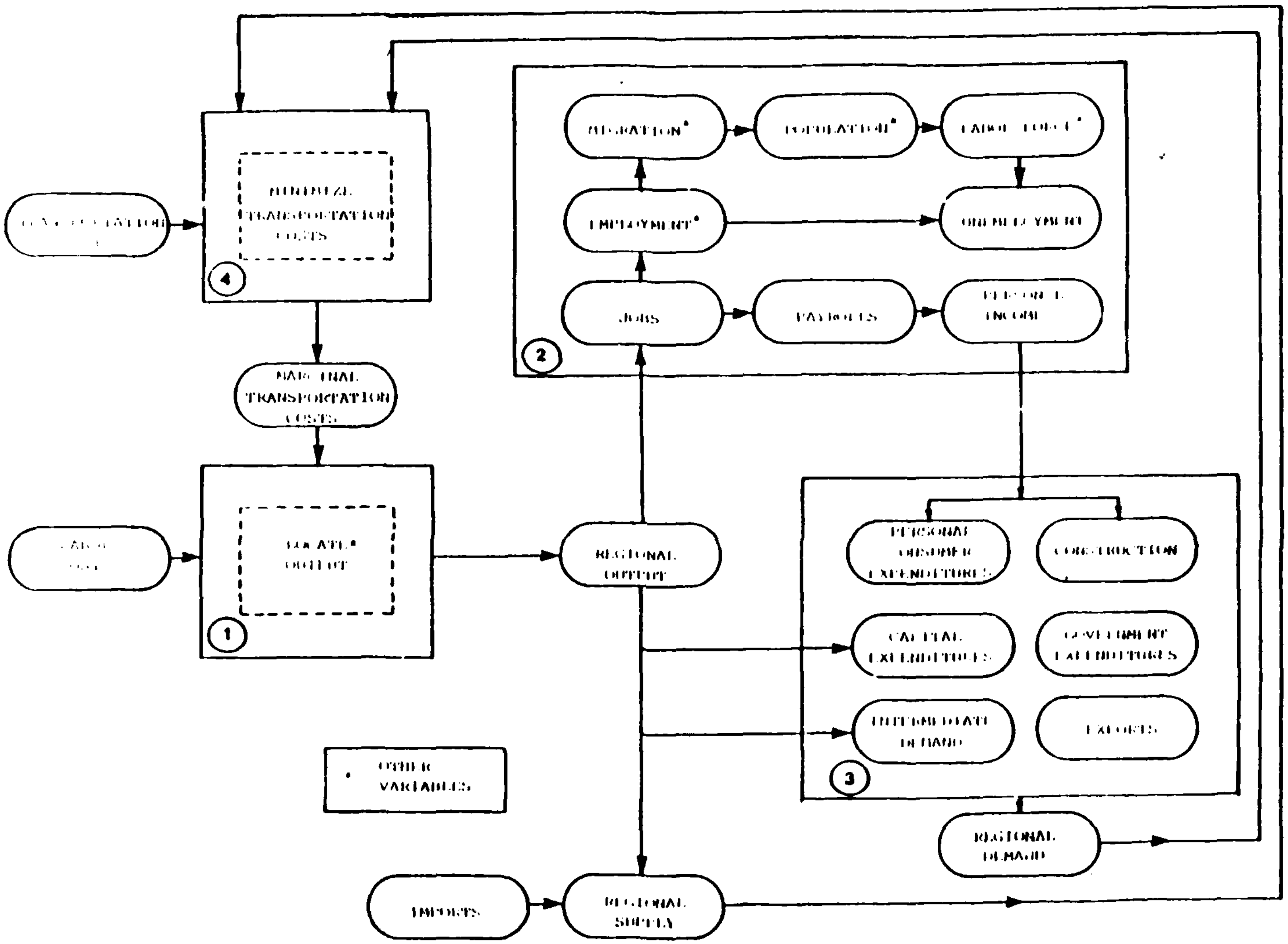

FIGURE 2-5 Integration of MRMI's Four Blocks

groupings defined in the forecasting model are shown in Table 2-1. The industrial sector classification used in the model is based upon the Department of Commerce input-output table. Sector disaggregation extends to the 2 and 3 digit Standard Industrial Classification (SIC) levels.

There are two operating versions of the model. One version considers the county as the basic geographic unit of analysis. The other considers the U.S. in terms of 585 regions consisting of 266 Standard Metropolitan Statistical Areas (SMSAs) and 183 non-SMSA portions of Bureau of Economic Analysis (BEA) economic areas. (Where SMSAs or non-SMSA portions of BEA areas cross state boundaries, the regions are disaggregated, accounting for the total of 585 regions. This facilitates aggregation to the state level, when necessary.)

The coefficients for explanatory variables in the equations of both versions of the model have been estimated from cross-sectional data collected for 3,103 counties of the United States. These data are based upon observations and estimates of county economic and demographic parameters for the years 1970 through 1974. Selected economic variables in the data base, notably earnings and employment, have recently been updated to 1976; historical population data will soon be current to 1980. Table 2-2 presents a summary account of major data sources used to create the regional data base.

TABLE 2-1

SECTORS IN THE MRMI FORECASTING MODEL

	Industry Sectors	SIC Numbers
1	Livestock	072, 074, 013, 0193, PT014
2	Crops	011, 012, PT014, 0192, 0199, 071, 073
3	Forestry	08
4	Fishery	09
5	Iron & Ferroalloy Ores Mining	101, 106
6	Nonferrous Metal Ores Mining	102, 103, 104, 105, 108, 109
7	Coal Mining	11, 12
8	Crude Petroleum & Natural Gas	13, -138
9	Stone, Clay, Chemical & Fertilizer Mining	14
10	Ordnance	
11	Meat Products	201
12	Dairy Products	202
13	Canned & Frozen Products	203
14	Grain Mill Products	204
15	Beverages	208
16	Miscellaneous Food Products	205, 206, 207, 209
17	Tobacco Products	21
18	Fabrics & Yarn	221, 222, 223, 224, 226, 228
19	Miscellaneous Textiles	227, 229
20	Apparel & Knitting	225, 23-239
21	Miscellaneous Fabricated Textiles	239
22	Lumber & Wood Products	24
23	Furniture & Fixtures	25
24	Pulp & Paper Mills	261, 262, 263
25	Paper Products	264, 265, 266
26	Printing & Publishing	27
27	Industrial Chemicals	281
28	Plastics & Synthetics	282
29	Drugs	283
30	Cleaning & Toilet Preparations	284
31	Paints & Allied Products	285
32	Agriculture Chemicals	287
33	Miscellaneous Chemicals	286, 289
34	Petroleum Refining	29
35	Tires & Tubes	301
36	Miscellaneous Rubber Products	302, 303, 306
37	Plastic Products	307
38	Leather & Leather Products	31
39	Stone, Clay & Glass Products	32
40	Iron & Steel	331, 332, 3391, 3399
41	Copper	3331, 334, 3351, 3362
42	Aluminum	3334, 3352, 3361
43	Miscellaneous Non-Ferrous Metals	3332, 3333, 3339, 3356, 3357, 3369, 339
44	Metal Containers	341, 3491

TABLE 2-1 (cont.)

45	Heating, Plumbing, Stamping & Screw Products	343, 345, 346
46	Structural Metal Products	344
47	Miscellaneous Fabricated Metal Products	342, 347, 348, 349, -3491
48	Engines & Turbines	351
49	Farm Equipment	352
50	Construction Mining Equipment	353
51	Metal Working Machinery	354
52	Industrial Machinery	355, 356
53	Office & Computer Machines	357
54	Service Industry Machines	358
55	Miscellaneous Machinery	359
56	Electrical Apparatus & Transmission Equipment	361, 362
57	Household Appliances	363
58	Electric Lighting & Wiring Equipment	364
59	Radio, T.V. & Communication Equipment	365, 366
60	Electronic Components	367
61	Miscellaneous Electrical Items	369
62	Motor Vehicles	371
63	Aircraft & Parts	372
64	Railroad Equipment	374
65	Miscellaneous Transportation Equipment	373, 375, 379
66	Scientific & Medical Instruments	381, 382, 384
67	Optical, Photo Equipment & Clocks	383, 385, 386, 387
68	Miscellaneous Manufacturing	39
69	Communication	48
70	Electric Utilities	491, 4931, 4939
71	Gas Utilities	492, 4932
72	Water & Sanitary Services	494, 495, 496, 497
73	Finance	60, 61, 62, 67
74	Insurance	63, 64
75	Real Estate	65, -656, 66
76	Hotels & Other Lodging Places	70
77	Personal & Repair Services	72, 76, -769
78	Business Services	73, 769, 81, 89, -892
79	Automobile Repairs	75
80	Amusements & Recreation	78, 79
81	Medical Services	80
82	Educational & Nonprofit Organizations	82, 84, 86, 892
83	Post Office	
84	Federal Government Enterprises	
85	State & Local Government Enterprises	
86	Construction	138, 15, 16, 17, 656
87	Maintenance Construction	
88	Railroad Transportation	40, 474
89	Buses & Local Transportation	41
90	Trucking & Warehousing	42, 473

91	Water Transportation	44
92	Air Transportation	45
93	Pipe Line Transportation	46
94	Transportation Services	471, 472, 478
95	Wholesale Trade	50
96	Lumber, Hardware, Farm Equipment Stores	52
97	General Merchandise Stores	53
98	Food Stores	54
99	Automotive Dealers	55, -554
100	Gasoline Service Stations	554
101	Apparel & Accessory Stores	56
102	Furniture Stores	57
103	Eating & Drinking Places	58
104	Miscellaneous Retail Stores	59
105	Private Households	88
106	State & Local Governments	92, 93
107	Federal Civilian Government	PT91
108	Armed Forces	PT91

Equipment Purchases by Sector

		Output Sectors
1	Agriculture	1-4
2	Mining	5-7, 9
3	Oil, natural gas	8
4	Construction	86-87
5-63	Manufacturing	10-68
64	Railroad	88
65	Trucking	90
66	Buses, waterways, and pipelines	89, 91, 93, 94
67	Air Transport	92
68	Communication	69
69	Electric utilities	70
70	Gas and water utilities	71, 72
71	Trade	95-104
72	Services	73-82
73	Personal auto	-

TABLE 2-1 (cont.)

Construction by Type

Private Construction

1	Single-family and mobile homes
2	Multi-family
3	Hotels, motels, cabin
4	Res. additions and alterations
5	Industrial
6	Offices
7	Stores, restaurants and garages
8	Religious
9	Educational, private
10	Hospital, private
11	Farm
12	Oil and gas drilling
13	Railroad
14	Telephone and telegram
15	Electric utilities
16	Pipeline and gas utilities
17	Miscellaneous, private

Public Construction

18	Military
19	Conservation and development
20	Highways
21	Public educational
22	Public health
23	Sewer systems
24	Water systems
25	Housing and urban development
26	Miscellaneous, public

TABLE 2-1 (cont.)

Federal Government Expenditures by Function

1 National defense, excluding contract procurement
2 International affairs and finance
3 Space research and technology
4 Farm incomes stabilization
5 Water resources and power
6 Land management
7 Mineral resources
8 Pollution control and abatement
9 Recreational resources
10 Air transportation
11 Water transportation
12 Ground transportation
13 Other commerce
14 Community development and housing, including rural
15 Education and manpower
16 Health
17 Income security
18 Veterans benefits and services
19 General government
20 Grants
21 Transfers
22 Loans

Miscellaneous Variables

Total household payroll
State and local government payroll
Federal government payroll
Military payroll
Total earnings by place of work
Commuters income
Total earnings by place of residence
Property income
Transfer payments
Social insurance payment
Personal income
Multi-job holders
In-commuters
Civilian persons employed by place of residence
Civilian labor force
Civilian unemployment
Transportation and trade output (17 sectors)

Table 2-2

DATA SOURCES FOR MRMI REGRESSION COEFFICIENTS

Variables	Source	Comments
Employment	Bureau of the Census and Bureau of Economic Analysis	Annual County Business Pattern data are controlled to BEA values.
Payrolls	Bureau of the Census and Bureau of Economic Analysis	Annual County Business Pattern data are controlled to BEA values.
Agriculture Output	Bureau of Economic Analysis	Annual value of sales for crops and livestocks by county are made available by BEA.
Mining Output	Bureau of the Census and Department of Interior, Bureau of Mines	1972 Census of Minerals reports mining output by counties. For other years state data is available.
Manufacturing Output	Bureau of the Census	Annual value of shipments are available for major counties.
Fishery Output	Department of Commerce	Annual value of fish landed and the number of fisherman are available at the state level.
Utilities Output	Department of Energy and Bureau of the Census	Annual data on sales of electricity and gas are obtained for each state.
Retail Trade Output	Bureau of the Census	The data on retail sales by type of store is available for counties from 1972 Census of Retail Trade. For the years other than 1972, total retail sales for the nation is reported.
Other Outputs: Forestry, Services, Communication, Transportation	INFORUM	

Variable	Source	Comments
Population	Bureau of Economic Analysis, Bureau of the Census	Annual figures for total county population for year 1970 by age and race groups are from Census of Population.
Births and Deaths	HEW, Public Health	Annual statistics on death and births by race and county of residence.
Unemployment	Bureau of Labor Statistics	Annual data on unemployment for most countries are available from Bureau of Labor Statistics.
Commuters	BEA	Annual data on commuters income by county are available from BEA.
Personal Consumtion Expenditures	Bureau of the Census	Data on retail sales by type of merchandise are available from 1972 Census of Retail Trade for SMSA's and rest-of-state areas.
Federal Government Expenditures	National Archives	Annual outlays of the Federal government by county are available for 80+ expenditure functions and 10 types.
State and Local Government Expenditures	Bureau of the Census	1972 Census of State and Local Government provides data on state government expenditures by state, and local expenditures by county for 32+ expenditure functions.
Private Construction Expenditure	Bureau of the Census	Annual figures on value of permits issued for residential and non-residential buildings are available for counties.
Public Construction Expenditure	Bureau of the Census	1972 Census of State and Local Governments provides expenditure data for construction by state and local governments.
Exports and Imports	Bureau of the Census	1976 data on exports and imports by ports of entry and exit.

The coefficients of the equations in the model are estimated by ordinary least squares procedures, using pooled cross-section and time-series data for the years 1970-74. The parameters are estimated using each county (or region) as an observation; that is, there is a separate equation for each industry but the same coefficients are used for a given industry in all regions. The decision to estimate coefficients with cross-section data is based on the hypothesis that both over time and across regions the same industries show the same basic economic behavior. In other words, the regional values of the estimated variables are a function of various other regional variables and their long-run behavioral relationship is assumed to remain stable. However, in order to capture the influence of those intangible economic, political and environmental conditions which are characteristic of a region but are not explicitly specified in the equations, regional estimates are corrected by a unique constant. In general, final estimates of regional economic activity are produced by adding to each forecast variable the value of residuals derived from OLS estimation procedures. The unique constant for a region with favorable economic or environmental conditions over the historic period, for example, would be positive.

The model's structure is recursive; supply and demand data associated with year t are used to forecast variables in year t+1. The output block contains the principal driving equations of the model from which employment, population, earnings, personal income and various components of regional final demand -- consumption, government expenditures, investment and foreign trade -- are derived.

All dependent variables in the model's equations are expressed in terms of regional shares of national totals rather than regional levels of output, employment, etc. This approach reduces serial correlation in coefficient estimates while still providing a straightforward means of estimating economic activity in forecast periods through the scaling of regional shares to exogenous national control totals. National controls are derived from INFORUM, the interindustry input-output model developed by Professor Clopper Almon, Jr. of the University of Maryland.[1] In addition to producing more reliable coefficient estimates, forecasting regional economic activity in terms of shares provides two additional advantages. First, the procedure ensures consistency with more reliable aggregate national forecasts and thus provides the required stability for generating long-term regional projections. Second, it expands the range of applications which may be undertaken with the model; exogenously specified policy impacts can be input through either the regional or national components of the model.

MRMI is one of the most extensively documented multiregional models in existence. Additional information about its theoretical

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[1]See Clopper Almon, Jr. et al, 1985: Interindustry Forecasts of the American Economy. Lexington, Mass: Lexington Books, 1974.

structure, data sources, and estimating procedures may be found in several references.[1]

2.3 Simulation of Regional Development Impacts

The indirect and induced impacts of public or private sector projects are calculated using the model by comparing a "perturbed" or impact forecast, which incorporates direct impacts attributable to the project, to a baseline forecast. The baseline forecast is constructed by first specifying a macroeconomic forecast, which consists of projections of gross national product, labor force, population, government spending and other variables. These projections are, in turn, the primary input data to INFORUM, the interindustry model that produces national control totals by

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[1]See, for example, Curtis C. Harris, Jr., The Urban Economies, 1985: A Multiregional, Multi-Industry Forecasting Model. Lexington, MA: Lexington Books, 1973; Curtis C. Harris, Jr. and Frank E. Hopkins, Locational Analysis: An Inter-regional Econometric Model of Agriculture, Mining, Manufacturing and Services. Lexington, MA: Lexington Books, 1972; Curtis C. Harris, Jr., Regional Economic Effects of Alternative Highway Systems. Cambridge, MA: Ballinger Publishing Co., 1974; Curtis C. Harris, Jr., "New Developments and Extensions of the Multiregional Multi-Industry Forecasting Model", Journal of Regional Science, 20:159-172, 1980.

industry and major economic indicator for MRMI. The regional baseline forecast results simply by constraining the MRMI's model's industry forecasts, aggregated over all regions, to the national control totals.

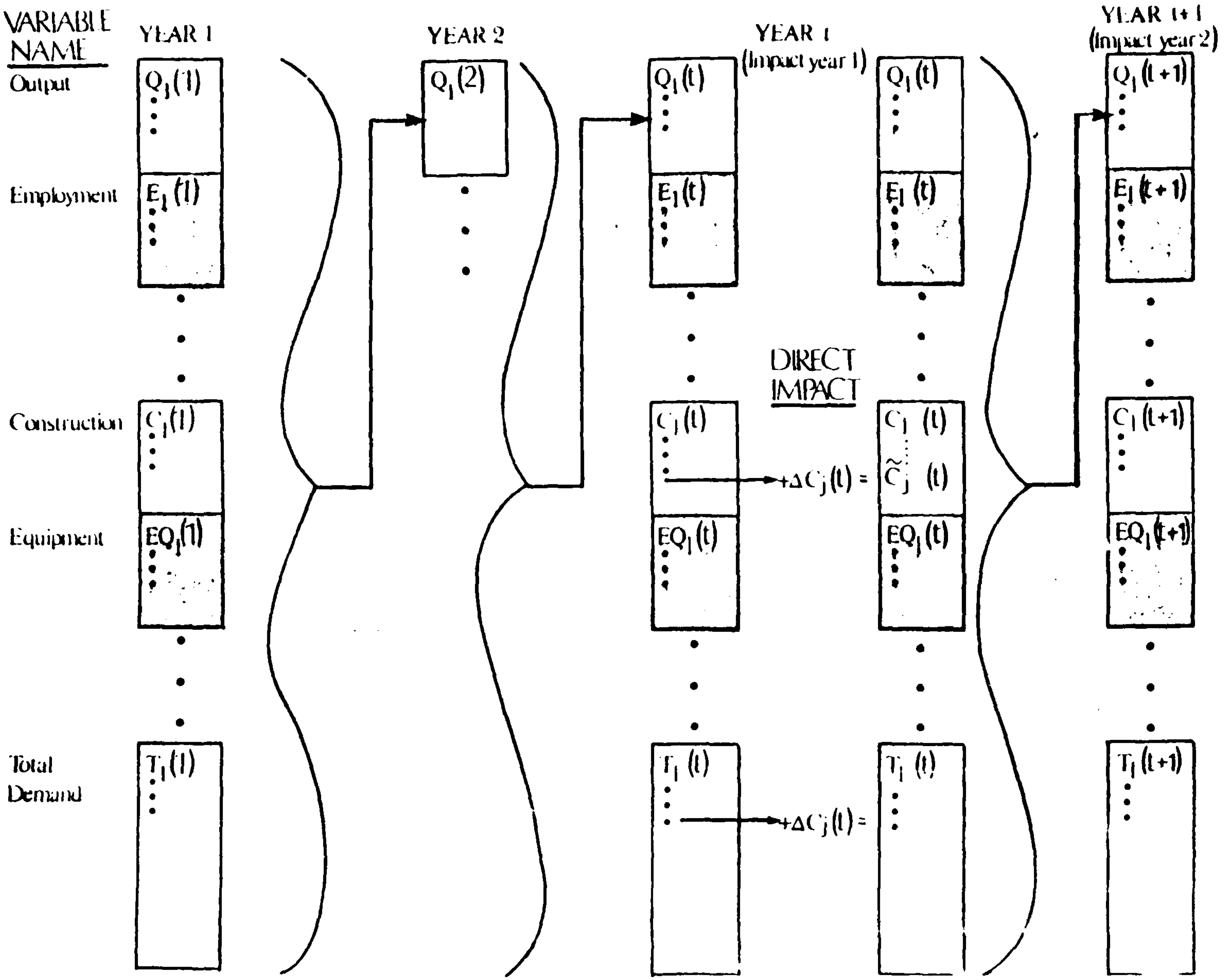
Procedures for developing the impact forecast vary according to the type of policy change being incorporated. While changes in policy at the national level require respecification of the macroeconomic and national interindustry forecasts, policy initiatives at the regional level usually do not, as investment associated with the latter is typically considered to represent a transfer of resources rather than a net addition to total national wealth. This procedure, it should be noted, implicitly assumes that transfers of economic activity among various industry sectors at the national level are not required to support the investment, ie. a given regional investment does not significantly change the distribution of total U.S. demand for the goods and services it produces. While in some cases, such as the construction of the Interstate Highway System, this assumption is probably invalid, it is not likely to introduce significant errors into regional forecasts in most applications.

Regional forecasts are "perturbed" by adding the direct impacts for a given year to the appropriate items in the regional data base before the data are used as lagged independent variables in the following year's output equations. To explain this procedure, consider a project that impacts only one construction sector, i, in a single region over a specified time period. The dollar magnitudes of these direct impacts are estimated outside of the model framework, usually from sources familiar with project construction. These calculations result in a vector of construction dollars, $C_i=(C_{i1}C_{i2},\ldots)$, that will be spent in the region in addition to those expenditures that are already anticipated for that sector in the baseline forecast. The construction increment for year t, ΔC_{it}, is therefore added to the value of construction, C_{it}, estimated by the model for sector i and year t before the next year's forecast is made. As construction is a component of total regional demand, and as the latter is a lagged independent variable in industry output equations, an exogenous change to construction in year t impacts output and other economic variables in year t+1. The differences in economic activity in year t+1 between estimates in the baseline forecast and estimates in the forecast using the modified lagged input data constitute the indirect and induced impacts associated with the direct construction impact in year t. These concepts are illustrated in Figure 2-6.

Clearly, most projects directly impact several economic activities and regions over time. However, the procedure for incorporating these impacts is, in principle, the same. Rather than adding a direct impact estimate to a single economic activity, a vector of impact estimates is added to specified sectors in appropriate regions for each year. In other words, the added complexity is merely an accounting rather than methodological problem.

FIGURE 2-6

INCORPORATION OF DIRECT IMPACTS INTO MRMI FORECASTS



CHAPTER 3

INPUT REQUIREMENTS FOR SIMULATING REGIONAL DEVELOPMENT IMPACTS

Projections of regional development impacts through a modeling framework such as MRMI are only as reliable as the data used to drive and perturb the model. While data need not be developed to estimate model coefficients (to "customize" the model to the region under study, so to speak), input requirements for forecasting with MRMI remain, as both national data and regional direct impact data must be developed for scenarios. This chapter details these requirements and introduces definitional considerations that must be followed in the data development stages in order to produce reasonable impact estimates.

3.1 Major Input Requirements

3.1.1 Considerations in Developing National Controls

As discussed in Chapter 2, regional baseline and impact forecasts require a set of <u>national controls</u> to enable MRMI estimates of regional shares to be converted to levels of economic and demographic activity. These national controls are derived in a two-stage process whereby first, a macroeconomic forecast is developed and then a national inter-industry forecast is made. As an existing national input-output model, INFORUM, is used to derive the latter, major data development activities at the national level involve macroeconomic forecasting and the conversion of INFORUM projections into a form compatible with data definitions in MRMI.

The macroeconomic forecast required for INFORUM is not a true macroeconomic forecast in itself as this national inter-industry model contains an endogenous macroeconomic component. Rather, the exogenous forecast consists of a set of projections of key parameters which are subsequently used to constrain the INFORUM macro to prescribed growth rates. As few as a dozen key macroeconomic series must be developed for this purpose.

Before projecting these series, however, it is necessary to determine whether a single set of national controls are appropriate for both baseline and impact scenarios. For most applications, a single set of national controls, and thus a single macroeconomic forecast, is used in all regional scenarios. This follows from the assumption that regional development activities, whether publically or privately initiated, usually involve a transfer of national resources from one region to another rather than a net addition to national wealth. Thus, the impacts that result from investing, say, $1 billion in a given region occur as the difference between economic activity in the region with the investment and economic activity in the region had the $1 billion been invested elsewhere. This is an important assumption to consider, for if the national economic consequences of regional economic development activities are misspecified as an increase in national wealth, comparative regional benefits will be overstated.

There are occasions when macroeconomic growth estimates should be different for baseline and impact scenarios, but these are usually large-scale multiregional projects which are accompanied by changes in revenue-producing policies at the state or federal government level. For example, an evaluation of the National System of Interstate and Defense Highways would require changing the macroeconomic forecast for the impact scenario to incorporate revenue-producing policies (gasoline excise taxes) adopted by the federal government in conjunction with the construction of the highway system. In general, however, projects requiring respecification of macroeconomic activity are rare.

INFORUM requirements for macroeconomic guidelines for developing national interindustry projections are few. The set of variables projected exogenously in the evaluation of the Coosa River Navigation Project consisted of the following:

- o population
- o households
- o percentage of households with age of head 25-34
- o government spending (both federal and state and local)
- o per capita disposal income
- o labor force
- o military employment
- o civilian employment (total, farm, non-farm, government)

Though few variables are exogenously specified and most of these variables are published in government and private sector forecasts, typical forecasting horizons associated with the evaluation of Corps projects severely limit the number of data sources that can be used to develop macroeconomic projections, as most long-term forecasts extend only to 1990 or 2000. Very long-term forecasts of several of the macroeconomic variables required for INFORUM are, however, published by the Bureau of Economic Analysis, U.S. Department of Commerce.[1] Other variables not available from this source must be extracted from other forecasts or projected independently using simple estimated relationships between the desired variables and long-term data series that are available. Examples of these procedures, used in the evaluation of the Coosa River Navigation Project, are given in Appendix I.

Some additional points to remember when forecasting macroeconomic growth are as follows:

- All dollar values must be expressed in 1972 dollars to be consistent with INFORUM input requirements; appropriate deflators are available from the U.S. Department of Commerce Survey of Current Business series.
- Macroeconomic projections may be specified in ten-year intervals; INFORUM will interpolate intervening year values automatically.
- As OBERS projections extend only to the year 2030, project evaluations which use a longer planning horizon must be based upon macroeconomic estimates extrapolated from this point in time; no comparable alternative projections have been found upon which to base a macroeconomic forecast.

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[1] Bureau of Economic Analysis, 1980 OBERS BEA Regional Projections. Volume 1: Methodology, Concepts and State Data. U.S. Department of Commerce, Washington, D.C., July 1981.

While the considerations for developing a macroeconomic driver for the national inter-industry model seem extensive, it should be noted that the "accuracy" of such forecasts is not critical, particularly when a single set of national controls is used to generate regional baseline and impact forecasts. This is so for two reasons. First, as regional development impacts are calculated by comparing an impact to a baseline scenario, it is more important that the national contexts associated with each are consistent with each other in a relative rather than absolute sense. Second, forecasting horizons longer than 10 to 15 years from the present accumulate so much error that even the most careful specifications of macroeconomic parameters cannot be expected to yield more than educated guesses about the long-term outlook for the U.S. economy. Structural changes in the U.S. economy, which are more or less inevitable but still cannot be anticipated, and international conflicts or other catastrophic events that could occur over the period will likely change the economy significantly but in a way which, at present, is indeterminant.

Procedures for converting INFORUM output into a form compatible with MRMI input requirements are straight-forward. For output, personal consumption expenditures, defense and other variables, 200-sector detail at the national level is aggregated to 104-sector detail for MRMI. Equipment and employment estimates must be expanded to 73 and 108 sectors, respectively. All dollar values are converted from 1977 to 1976 dollars. As user interaction is not required at this stage, further elaboration about the methodology is not necessary.

3.1.2 Form and Structure of Regional Impact Data

If MRMI is to provide reasonable estimates of regional development benefits, impact data must be consistent with variable definitions in the model because coefficient estimates are based upon rigid conventions imposed upon the data. In formulating scenarios, it is the users responsibility for providing direct impacts data. MRMI calculates the indirect and induced impacts associated with these direct stimuli to regional economies. As dicussed in the previous chapter, the model characterizes regional economies in terms of distinct sectors which are groupings of 2, 3 and 4-digit SIC industries and in terms of variables such as output, employment, payrolls, etc. Dollar data are expressed in thousands of 1976 dollars while demographic data (e.g., employment, population, etc.) are actuals.

Typically, the evaluation of regional development impacts involves two phases of the project under investigation: one related to construction and the other to the operation of the project. Direct impacts associated with each phase usually affect different sectors of the model.

When characterizing the construction phases of the project, direct impacts should be expressed in terms of construction and equipment expenditures. Construction expenditures, as defined in the model, account for all expenditures _except_ equipment purchases. A total of 26 expenditure categories are recognized, including 17 private and 9 public construction categories. Waterway construction would impact Public Construction - Water Systems (Section 24), for example. While the equipment expenditure component of the model recognizes 73 expenditure categories, it is important to note that direct equipment expenditure impacts are associated with the _buyers_ of equipment, not the producers. Thus, direct impacts associated with waterway construction increment Equipment Purchasing Sector 66 - Buses, Waterways, and Pipelines.

Note that direct impacts are associated with expenditure categories rather than employment, as in other models. MRMI is structured such that direct employment impacts associated with construction and equipment expenditures are consequences of these expenditures through employment equations in the model. Thus, the development of direct impact data during the construction phase of the project is straightforward, involving only the mapping of expenditure data into appropriate construction and equipment sectors. As the model projects regional economic activity on an annual basis, direct impact data must be expressed in annual terms in order for MRMI to calculate the indirect and induced impacts correctly.

Direct impacts associated with the operational phase of the project are generally much more variable in terms of sectors and economic variables affected, and are essentially dependent upon the nature of the project under consideration. Waterway projects, for example, can affect transportation costs, revenues of competing transportation modes, consumption expenditures for recreation and other variables, once they are operating. These impacts in turn affect location rents (and hence output), output and personal consumption expenditures. Only one "constant" impact-type can be associated with the operational phase -- operation, maintenance and equipment replacement expend res. For a federal project, such as a waterway, equipment replacement expenditures are allocated to the same equipment expenditure sector as in the construction phase, because the buyer is still the wararway. Operation and maintenance expenditures (for labor, etc.) are allocated to Federal Government Expenditures - Sector 11: Water Transportation. Again, all direct impacts associated with the operational phase of the project are expressed in annual terms.

3.2 Defining Impact Regions and its Effect on Input Data Requirements

The MRMI data base and forecasting routines are "regionally exhaustive" in that the model projects economic and demographic activity for all regions of the United States. The regions it considers comprise 3,103 counties or 585 SMSAs and non-SMSA portion of BEA economic areas, depending upon the version of the model being used. Impact regions may be individual counties or economic areas, or aggregations of them. Usually the individual economies of each county or economic area in the impact [illegible] are retained in the model to examine distributional [illegible] within the regions. Impact regions in the Coosa River [illegible] comprised an eight-county corridor region [illegible] the project; a ten-county spatially dispersed [illegible] trading partners to the corridor region; the rest of Alabama, the host state; and the rest of the United States. Individual county economies in the first three regions were [illegible] while the rest of the U.S. region was a single aggregation of all remaining county economies in the country. [illegible] regions took both economic and political [illegible].

A critical aspect of regional delineation relates not to the inclusion or exclusion of counties or economic areas into the impact region but to the problem of allocating direct impacts to the individual economies within the impact area. The infusion of capital into a region does not, in actuality, occur at a point in space but instead is distributed throughout the region to individual establishments. The distribution of capital is often constrained to achieve certain social objectives, such as mandating that specific employment or other goals be achieved within the region.

In all but the most trivial case (a one-county direct impact area), this distribution must be assumed because its actual form is unknown. But it is important to approximate the distribution fairly closely because biases can be introduced into forecasts. Because the individual county or economic area economies possess distinct multipliers, mis-allocated direct impacts will be transmitted through the local economies incorrectly, biasing indirect and induced impacts from their "correct" values.

If a single region comprises the impact area and if impacts are highly localized, the incorporation of direct impacts into the model is straightforward, involving the allocation of all expenditures and structural changes to the region. Usually, however, the impact areas are multi-county conglomerations, requiring some allocation rule for distributing direct impacts.

While no hard-and-fast rules can be suggested for distributing impacts, an "adaptive" decision process can be followed to approximate the distribution. It consists of the following steps:

(1) Allocate direct impacts by type (construction expenditures, equipment investment, etc.) between the directly impacted region and other regions in the model. (Not all direct impacts are local.) The decision-rule for allocating impacts between these regions could be:

(a) arbitary

(b) based upon information in the project description

(c) based on distributional mandates in enabling or appropriation legislation

(d) based on the characteristics of goods or services required (i.e., certain equipment requirements culled from project documentation may be specialized and unavailable in directly impacted regions; a good example of this is the many components used to construct nuclear power plants which are rarely available in host regions)

(2) For direct impacts in <u>local</u> or <u>directly impacted</u> areas:

(a) Define a "probable impact area" using a simple decision rule; e.g., for a project located in a single county, delineate the probable impact area as the host county and all adjacent counties (which may only be a part of the entire impact area).

(b) Evaluate the economies of each county in the probable impact area to determine their present capacities and their potential for providing the required goods or services. Counties unable to meet project demands should be eliminated from the allocation procedure (but not from the direct impact area). Other counties could possibly be substituted for those eliminated.

(c) Distribute direct impacts to eligible counties using economic or demographic proxies such as output, employment or population, as weighting factors.

(3) For allocating direct impacts to non-local areas:

(a) Allocate impacts to these regions using appropriate economic or demographic proxies as weighting factors, or

(b) If the origins of required goods or materials are known, allocate this subset of direct impacts deterministically and distribute the remaining impacts by method 3(a).

It must be emphasized that the above decision-rules are adaptive and are subject to ad hoc changes as the situation dictates. In many cases, the most simple-minded approach may be perfectly adequate although some senstivity testing with different allocations may be appropriate at this stage before regional impact forecasts are made. If different allocation formulas yield significantly different direct impact distributions and the "correct" distribution cannot be distinguished, it might be appropriate to undertake several impact forecasts to "bracket" the distribution of indirect and induced impact estimates.

Note that the allocation of direct impacts for the operational phase of the project is usually less problematic, given that the project has been conceived to achieve certain objectives (e.g., reducing transportation costs between various nodes in the region). Some allocation procedures may still be necessary, however. In the evaluation of the Coosa River Navigation Project, which assessed the regional development benefits of opening the Coosa River to water transportation between Montgomery and Gadsden, Alabama, direct operating impacts and their allocations consisted of the following:

(1) Reduced transportation costs for shipping specified commodities between origin-destination pairs -- here, directly impacted regions were identified from project documentation, and no allocation rules were necessary.

(2) Increased output from the Water Transportation sector -- the total estimated increase in output was allocated to Water Transportation output in counties comprising the origin-destination pairs according to shipping projections in project documentation.

(3) Decreased output in the Railroad sector -- increases in Water Transportation output in origin-destination counties were subtracted from Railroad sector output in the same counties.

(4) Decreased Electric Utilities output caused by the installation of locks into existing hydropower dams -- output was subtracted from counties where revenues from power generated by the dams were received.

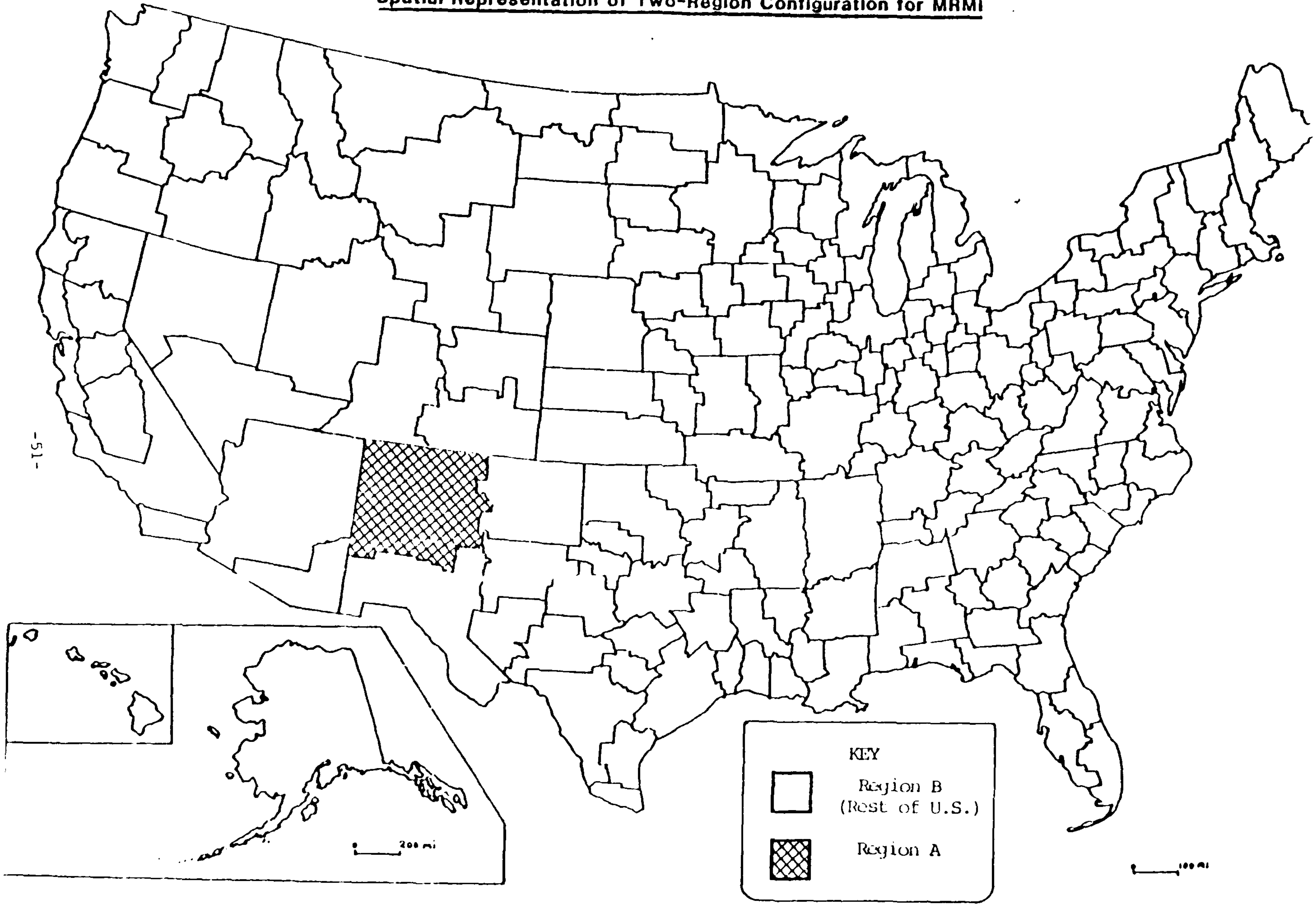
In this case, regions directly impacted were determined more from project documentation and simple allocations than any sophisticated methodological procedure.

An important practice to adopt when allocating direct impacts to regions is to maintain a strict accounting scheme relative to the national controls imposed upon the forecast. The significance of this can be illustrated by a simple example.

Consider a project that impacts a single region, A (Figure 3-1). In this case, the model would be configured to recognize the

FIGURE 3-1

Spatial Representation of Two-Region Configuration for MRMI



economies of region A and region B, an aggregation of all other regions in the U.S. Now assume that both the baseline and impact scenarios were constrained to identical national control forecasts and that the only direct impacts attributable to the project were construction outlays in the host region. Procedures for incorporating direct impacts into model forecasts require us to add the construction expenditures, C(t), for the year t to the construction expenditure sector associated with the host region. But to be consistent with the common national economic scenario, we are compelled to subtract C(t) from the construction expenditure sector of the rest of United States region at the same time, since the identical national forecasts imply no net increase in construction expenditures in the national economy. This is an important point, for failure to account for these implicit inter-regional transfers can distort the model's indirect and induced impact estimates.

Obviously, the accounting for transfers becomes more complicated when the situation is generalized to several impacted regions and sectors in typical impact forecasts. Furthermore, these "negative impacts" (transfers) must often, themselves, be allocated among several regions. In addition, the sum of direct impact transfers need not equal zero if alternative national economic scenarios are specified for baseline and impact forecasts at the regional level. But the accounting principles in this situation are the same, and if they are followed will produce consistent regional forecasts. An example of a strict accounting regimen for allocating several types of direct impacts to sever_l regions is shown in Figure 3-2.

3.3 Data Sources for Direct Impact Estimates

MRMI's data requirements for calculating indirect and induced impacts from direct impact estimates are fewer than other models because the model is supported by an extensive, built-in data base for all counties and economic areas in the U.S. Its sole data needs are direct impact estimates which may be obtained from primary or secondary sources.

In the Coosa River Navigation Project, most direct impact estimates were provided by the Corps. For the construction phase of the project, construction and equipment expenditure data were culled from the General Design Memorandum for the project. Operational impacts, which consisted of transportation cost savings and revenue impacts on the water and rail transportation sectors, were derived from a traffic survey of potential users conducted by the Corps.

In the absence of impact data specifically developed for the project under study itself, several secondary data sources may be available relating to similar previously-evaluated projects, although, at times, the transfer of data to the new economic context may not be appropriate. As the data requirements for estimating regional impact scenarios are so small, however, direct engineering and survey estimates are the best sources for generating reliable forecasts.

Figure 3-2

Sample Accounting Scheme for Incorporating Direct Impacts

Impacted Sector:________________ Sector #:_______ Units:____________

County/Region Name	1980	1981	1982	1983	1984 ...
(region 1)	475				
(region 2)	87				
(region 3)	56				
.					
.					
.					
(region n)	30				
Rest-of-nation	-1,760				
Total Impact on National Economy	0				

3.4 Consistency Considerations for Incorporating Direct Impact Data

This section of the chapter is essentially a structured overview of the consistency issues that must be considered when formulating baseline and impact scenarios for evaluation using MRMI.

1. National control forecasts for the multiregional model require the specification of one or more macroeconomic scenarios, each consisting of projections of as few as a dozen key macroeconomic parameters. A sample set of these parameters have been given in Section 3.1.1, and candidate sources and techniques for estimating macroeconomic activity over long-term planning and evaluation horizons have been identified. Dollar estimates of macroeconomic activity must be deflated to 1972 dollars to satisfy the input requirements of INFORUM, the national input-output model that generates national controls for all of the variables forecast by the MRMI model. Key macroeconomic series need only be projected at ten year intervals over the forecasting period as annual values are interpolated automatically by INFORUM.

2. Direct regional impact data are incorporated by incrementing appropriate sectors in the model by the impact before forecasting the following year's economic activity. Impact data must therefore be consistent with definitional conventions in the model and, in the case of dollar estimates, must be expressed in 1976 dollars. As the model produces annual forecasts, impact data

must also be annualized. When direct impacts involve the purchase of goods or services, economic activity of the purchaser is changed to characterize the impacts.

3. A flexible, consistent allocation procedure must be developed to distribute direct impacts among the individual economies that comprise the impact regions. As the distribution direct impacts can influence the magnitude and incidence of indirect and induced impacts, several impact forecasts may be appropriate, particularly if the "true" distribution cannot be inferred. An example of an adaptive procedure for distributing direct impacts among host regions is provided in Section 3.2.

4. The allocation of direct impacts among regions must be consistent in relation to the national contexts in which the baseline and impact scenarios have been formulated. In other words, the interregional transfer of resources must be recognized in the allocation procedures for regional impact estimates to be consistent. An accounting scheme was devised in Section 3.3 to ensure consistency at this level.

5. Actual data requirements for calculating regional development impacts using MRMI are minimal since an extensive economic data base is already incorporated into the model. Only direct impact estimates, obtainable from engineering and survey data, or from secondary sources, must be developed to simulate regional economies with and without the proposed project.

If these steps are f llowed, consistent and reliable estimates of the indirect and induced impacts of project construction and operation will be generated by the model.

CHAPTER 4

EXECUTION OF MRMI AND INTERPRETATION OF MODEL OUTPUT

The regional economic baseline and impact forecasts are end results of a multi-step data processing exercise. They require at least one macroeconomic and one inter-industry forecast plus additional processing tasks to introduce impacts into the regional economies. This chapter outlines the steps that are necessary to complete these tasks. It then reviews the form and structure of the model's output and finally describes various programming aids that are available for interpreting the forecasts.

4.1 An Overview of MRMI Run Procedures

MRMI forecasts are incrementally produced by successively completing distinct data development and data processing tasks. While the tasks themselves are reviewed here sequentially, it is important to note that some tasks can be performed simultaneously, reducing the time required to generate the forecasts. An outline and explanation of the procedure follows:

(1) Project key macroeconomic series to constrain INFORUM national inter-industry projections. This task does not require data processing capabilities unless fairly sophisticated forecasting techniques are used. Usually, macroeconomic series are either extrapolated from existing trends or are projected using very simple relationships to other series. Both of these techniques can be programmed into a hand-held calculator. The resulting series are passed to INFORUM for further processing.

(2) Generate a national inter-industry forecast to produce national control totals for MRMI. This task must be performed by the INFORUM consulting group at the University of Maryland and is essentially a "black box" in the modeling sequence.

(3) Convert the national inter-industry forecast into a national control file for MRMI. This task involves running two programs. The first merges to two major output files from INFORUM and deflates dollar estimates from 1977 to 1976 dollars. The second aggregates 200-sector detail from INFORUM forecasts to 104 sectors and expands forecasts to 73 and 96 sectors respectively. The outcome is a national control file structured identically to MRMI's regional data files containing national estimates of all regional variables in the data base.

(4) Configure the model into a form that recognizes the regions that are to be evaluated. This is a "housekeeping" task only and involves the identification of all counties or economic areas in the various impact regions, and the aggregation of all other counties into a "rest-of-nation" region. The latter step is undertaken mainly to achieve economies of operation. The actual identification of impact regions for analysis purposes is not made until the analysis programs are directed to treat them as such. All sub-regional economies that were explicitly identified by the user (not aggregated into the "rest-of-nation" region) are allowed to function interdependently to preserve the multiregional nature of the model.

(5) Generate a baseline regional forecast. The model is essentially independent of the parameters that govern its operation, i.e. no source code changes have to be made to customize the model to specific applications. All relevant information concerning the scenario is contained in a "set-up" file which informs the program about the beginning and end years of the forecast, the number of regions to be processed, the forecast files (years) to be retained (all others are scratched), and the names of input and output files that have to be attached for the model to run. Input files consist of:

(a) a "coefficients" file for the model's equations
(b) a "ratios" file for internal calculations
(c) a national control file

(d) a "residuals" file to calibrate forecasts to regional conditions
(e) a file of national input-output coefficients for internal calculations
(f) a "lag-year" file of complete regional data, which serves as an input file for the current year forecast

Output files consist of a "ratios" file for the last year of the forecast, and the files containing the regional forecasts of selected forecast years.

(6) Develop direct impact data and allocate the data to the county or economic area economies that make up the impact regions. These issues have been covered at length in the previous chapter. After the data have been made compatible with conventions in the model and impacts have been spatially allocated to counties or economic areas, they must be entered into a data file so that direct impacts can be incorporated into the impact scenario. Rigid coding formats are not required when inputting the data because the data must be reprocessed to effect the overlay of direct impact estimates onto their counterparts in the lag-year data base.

(7) Generate an impact forecast. Run procedures for generating an impact forecast are nearly identical to those of the baseline forecast. Input files are identical (unless a second national control file has been developed for the impact scenario) and output files are renamed to permit the distinction of scenarios for later comparative analyses. The only change is that MRMI must be "stalled" just as it is about to start processing for the next forecast year so that direct impact data can be overlayed onto the new lag-year file. This procedure can be performed manually by stopping the model after each year's forecast is complete, adding the direct impacts to the lag-year file, running out another year's forecast, and so on. It can also be performed automatically by activating a subroutine in the model.

(8) Analyze the model's output. Because MRMI forecasts so much data, regional forecasts are not directly interpretable from unprocessed output files. Several programs have been developed to facilitate the analysis task. Both model output and analytical aids are discussed in subsequent sections of this chapter.

While the procedures for developing regional forecasts appear imposing, they are, in fact, quite straightforward. Programmer interaction with the model itself is minimal and analysis programs make it relatively easy to retrieve and display data from the model's data base.

The model currently resides on a Prime 550 mini-computer. Execution time varies with the number of regions and years but can be approximated by assuming a unit execution time to be 0.1 minute per region and year.

4.2 Output from the Model

Output generated by the model is a series of cross-sectional data bases, each containing measures of economic and demographic activity for all regions explicitly recognized by the model for a single year (Figure 4-1). Each data base is a separate data file (written in binary) and the user has the option of selecting which files (forecast years) to keep. Because of its recursive nature, the model must produce a complete data file every year of the forecast to generate input data for the next forecast year. But as soon as their functions are performed, the files are scratched to minimize storage requirements. About 23 K-bytes of storage are required for each region for each year of the forecast. A complete data dictionary for the regional data is given in Table 4-1 and 4-2.

4.3 Programming Aids for Interpreting Model Output

Because of the sheer size of the data base, several programming aids have been developed to facilitate the analysis of forecasts.

Figure 4-1

Structure of the MRMI Model's Output Data

Region 1 ⋮ data ⋮ Region 2 ⋮ data ⋮ ⋮ Region n ⋮ data ⋮	Forecast year 1 (t_1)
Region 1 ⋮ data ⋮ Region 2 ⋮ data ⋮ ⋮ Region n ⋮ data ⋮	Forecast year (t_2)
⋮	⋮
Region 1 ⋮ data ⋮ Region 2 ⋮ data ⋮ ⋮ Region n ⋮ data ⋮	Forecast year m (t_m)

Table 4-1

Data Dictionary for Variables in MRMI's Regional Data Base[1]

1. HEADER RECORD

Sequence	Format	Description
1	I6	Forecast year
2	I6	Sequence number
3	I6	SMSA code
4	I6	BEA economic area
5	I6	FIPS state code
6	I6	FIPS county code
7	A6	State name
8	5A6	County name

2. NUMERICAL DATA

Sequence	Variable No.[2]	Description
1	-	Land area
2	-	Factor (internal use only)
3-106	1-104	Domestic output by 104 industry sectors
107	105	Sum of output
108-211	1-104	Payrolls (earnings) by 104 industry sectors
212	105	Household payroll
213	106	State & local government payroll
214	107	Federal government payroll
215	108	Military payroll
216	109	Total earnings by place of work
217	110	Commuters income
218	111	Total earinings by place of residence
219	112	Property income
220	113	Transfer payments
221	114	Social insurance payment
222	115	Personal income
223-226	1-4	White population by 4 age cohorts
227-230	5-8	Non-white population by 4 age cohorts
231-234	9-12	White deaths by 4 age cohorts
235-238	13-16	Non-white deaths by 4 age cohorts
239	17	White births
240	18	Non-white births
241	19	Total population

Table 4-1 (cont'd)

Data Dictionary for Variable in MRMI's
Regional Data Base[1]

2. NUMERICAL DATA (cont'd)

Sequence	Variable No.[2]	Description
242-345	1-104	Employment by 104 industry sectors
346	105	Household employment
347	106	State & local government employment
348	107	Federal government employment
349	108	Military employment
350	109	Sum of employment by place of work
351	110	Multi-job holders
352	111	In-commuters
353	112	Net commuters (out minus in)
354	113	Civilian persons employed by place of residence
355	114	Civilian labor force
356	115	Civilian unemployment
357-460	1-104	POE by 104 industry sectors
461	105	Sum of PCE
462-565	1-104	Defense expenditures by 104 industry sectors
566	105	Sum of defense
567-639	1-73	Equipment purchases by 73 sectors
640	74	Sum of equipment investment
641-666	1-26	Construction expenditures by 26 types
667	27	Sum of construction
668	1	Agriculture land value
669-804	-	Internal use only
805-908	1-104	Exports by 104 industry sectors
909	105	Sum of exports
910-103	1-104	Competitive imports by 104 industry sectors
1014-1016	105-107	Non-competitive imports
1017	108	Sum of imports
1018-1039	1-22	Federal government expenditures by function
1040	23	State and local government expenditures

Table 4-1 (cont'd)

Data Dictionary for Variables in MRMI's
Regional Data Base[1]

2. NUMERICAL DATA (cont'd)

Sequence	Variable No.[2]	Description
1041	24	Sum of federal government expenditures
1042-1118	-	Blank
1119-1222	1-104	Total demand by 104 industry sectors
1223-1326	-	Internal use only
1327-1343	1-17	Transportation and trade output by 17 (88-104) sectors.
1344-1447	-	Internal use only

[1]Dollar values are expressed in thousands of 1976 dollars. Non-dollar values (for demographic variables) are actuals. A glossary defining the economic variables in MRMI is given in Appendix II.

[2]Refer to sector definitions in Table 4-2 to associate variable numbers to specific sectors

[3]The in-commuters field is blank in economic area data bases.

TABLE 4-2

SECTORS IN THE MRMI FORECASTING MODEL

Sector No.	Industry	SIC Codes
1	Livestock	072, 074, 013, 0193, PT014
2	Crops	011, 012, PT014, 0192, 0199, 071, 073
3	Forestry	08
4	Fishery	09
5	Iron & Ferroalloy Ores Mining	101, 106
6	Nonferrous Metal Ores Mining	102, 103, 104, 105, 108, 109
7	Coal Mining	11, 12
8	Crude Petroleum & Natural Gas	13, -138
9	Stone, Clay, Chemical & Fertilizer Mining	14
10	Ordnance	
11	Meat Products	201
12	Dairy Products	202
13	Canned & Frozen Products	203
14	Grain Mill Products	204
15	Beverages	208
16	Miscellaneous Food Products	205, 206, 207, 209
17	Tobacco Products	21
18	Fabrics & Yarn	221, 222, 223, 224, 226, 228
19	Miscellaneous Textiles	227, 229
20	Apparel & Knitting	225, 23-239
21	Miscellaneous Fabricated Textiles	239
22	Lumber & Wood Products	24
23	Furniture & Fixtures	25
24	Pulp & Paper Mills	261, 262, 263
25	Paper Products	264, 265, 266
26	Printing & Publishing	27
27	Industrial Chemicals	281
28	Plastics & Synthetics	282
29	Drugs	283
30	Cleaning & Toilet Preparations	284
31	Paints & Allied Products	285
32	Agriculture Chemicals	287
33	Miscellaneous Chemicals	286, 289
34	Petroleum Refining	29
35	Tires & Tubes	301
36	Miscellaneous Rubber Products	302, 303, 306
37	Plastic Products	307
38	Leather & Leather Products	31
39	Stone, Clay & Glass Products	32
40	Iron & Steel	331, 332, 3391, 3399
41	Copper	3331, 334, 3351, 3362
42	Aluminum	3334, 3352, 3361
43	Miscellaneous Non-Ferrous Metals	3332, 3333, 3339, 3356, 3357, 3369, 339
44	Metal Containers	341, 3491

TABLE 4-2 (Cont'd)

Sector No.	Industry	SIC Codes
45	Heating, Plumbing, Stamping & Screw Products	343, 345, 346
46	Structural Metal Products	344
47	Miscellaneous Fabricated Metal Products	342, 347, 348, 349, -3491
48	Engines & Turbines	351
49	Farm Equipment	352
50	Construction Mining Equipment	353
51	Metal Working Machinery	354
52	Industrial Machinery	355, 356
53	Office & Computer Machines	357
54	Service Industry Machines	358
55	Miscellaneous Machinery	359
56	Electrical Apparatus & Transmission Equipment	361, 362
57	Household Appliances	363
58	Electric Lighting & Wiring Equipment	364
59	Radio, T.V. & Communication Equipment	365, 366
60	Electronic Components	367
61	Miscellaneous Electrical Items	369
62	Motor Vehicles	371
63	Aircraft & Parts	372
64	Railroad Equipment	374
65	Miscellaneous Transportation Equipment	373, 375, 379
66	Scientific & Medical Instruments	381, 382, 384
67	Optical, Photo Equipment & Clocks	383, 385, 386, 387
68	Miscellaneous Manufacturing	39
69	Communication	48
70	Electric Utilities	491, 4931, 4939
71	Gas Utilities	492, 4932
72	Water & Sanitary Services	494, 495, 496, 497
73	Finance	60,61, 62, 67
74	Insurance	63, 64
75	Real Estate	65, -656, 66
76	Hotels & Other Lodging Places	70
77	Personal & Repair Services	72, 76, -769
78	Business Services	73, 769, 81, 89, -892
79	Automobile Repairs	75
80	Amusements & Recreation	78, 79
81	Medical Services	80
82	Educational & Nonprofit Organizations	82, 84, 86, 892
83	Post Office	
84	Federal Government Enterprises	
85	State & Local Government Enterprises	
86	Construction	138, 15, 16, 17, 656
87	Maintenance Construction	
88	Railroad Transportation	40, 474
89	Buses & Local Transportation	41
90	Trucking & Warehousing	42, 473

[illegible] (Cont'd)

Sector No.	Industry	SIC Codes
91	Water Transportation	44
92	Air Transportation	45
93	Pipe Line Transportation	46
94	Transportation Services	471, 472, 478
95	Wholesale Trade	50
96	Lumber, Hardware, Farm Equipment Stores	52
97	General Merchandise Stores	53
98	Food Stores	54
99	Automotive Dealers	55, -554
100	Gasoline Service Stations	554
101	Apparel & Accessory Stores	56
102	Furniture Stores	57
103	Eating & Drinking Places	58
104	Miscellaneous Retail Stores	59
105	Private Households	88
106	State & Local Governments	92, 93
107	Federal Civilian Government	PT91
108	Armed Forces	PT91

Equipment Purchases by Sector

		Mapping Output Sectors
1	Agriculture	1-4
2	Mining	5-7, 9
3	Oil, natural gas	8
4	Construction	86-87
5-63	Manufacturing	10-68
64	Railroad	88
65	Trucking	90
66	Buses, waterways, and pipelines	89, 91, 93, 94
67	Air Transport	92
68	Communication	69
69	Electric utilities	70
70	Gas and water utilities	71, 72
71	Trade	95-104
72	Services	73-82
73	Personal auto	-

TABLE 4-2 (Cont'd)

Construction by Type

Private Construction

1	Single-family and mobile homes
2	Multi-family
3	Hotels, motels, cabin
4	Res. additions and alterations
5	Industrial
6	Offices
7	Stores, restaurants and garages
8	Religious
9	Educational, private
10	Hospital, private
11	Farm
12	Oil and gas drilling
13	Railroad
14	Telephone and telegram
15	Electric utilities
16	Pipeline and gas utilities
17	Miscellaneous, private

Public Construction

18	Military
19	Conservation and development
20	Highways
21	Public educational
22	Public health
23	Sewer systems
24	Water systems
25	Housing and urban development
26	Miscellaneous, public

TABLE 4-2 (Cont'd)

Federal Government Expenditures by Function

1 National defense, excluding contract procurement
2 International affairs and finance
3 Space research and technology
4 Farm incomes stabilization
5 Water resources and power
6 Land management
7 Mineral resources
8 Pollution control and abatement
9 Recreational resources
10 Air transportation
11 Water transportation
12 Ground transportation
13 Other commerce
14 Community development and housing, including rural
15 Education and manpower
16 Health
17 Income security
18 Veterans benefits and services
19 General government
20 Grants
21 Transfers
22 Loans

Miscellaneous Variables

Total household payroll
State and local government payroll
Federal government payroll
Military payroll
Total earnings by place of work
Commuters income
Total earnings by place of residence
Property income
Transfer payments
Social insurance payment
Personal income
Multi-job holders
In-commuters
Civilian persons employed by place of residence
Civilian labor force
Civilian unemployment
Transportation and trade output (17 sectors)

At present, these programs must be customized slightly for each application so that correct regions or regional aggregations are retrieved. Modifications to the source code involve only changes to DATA, DIMENSION and file reference statements. One of the analysis programs (GENREG.FORT) is completely interactive, allowing the user greater flexibility for choosing regions, economic variables and forecast years to analyze. Two of these programs analyze the baseline and impact forecasts individually, i.e. they estimate activity levels in selected regions allowing the user to assess the economic characteristics of the regions and to compare these activity levels with other forecasts or historical data. The other two programs take output optionally generated from the first two and compare the impact to baseline scenarios over prescribed economic indicators. Source code for the programs is written in FORTRAN. A brief description of each follows.

GENIND.FORT: This program retrieves pre-specified general economic indicators from the regional data base for selected years and for the major regional aggregates under study. The economic activity of each region is then displayed in tabular form (Table 4-3), one for each region. The extracted series provide a good analytical base for evaluating and verifying model forecasts. The user has the option of generating an on-line data file of the tabulated results which can be used subsequently by one of the comparison programs.

REGIONAL SUMMARIES OF KEY ECONOMIC INDICATORS — BASELINE SCENARIO

REGION 1: WATERWAY CORRIDOR

VARIABLE NAME	1983	1984	1985	1986	1987	1988	1989	ANNUAL GROWTH RATES(%) 83-85	85-89	83-89
OUTPUT (THOUSANDS OF 76$)										
AGRICULTURE,FORESTRY,FISHERIES	252563.	262868.	272340.	277952.	283177.	288398.	293731.	3.84	1.91	2.55
MINING	97604.	104307.	109310.	110320.	111718.	113484.	115677.	5.83	1.43	2.87
CONSTRUCTION	313191.	340432.	359793.	362328.	369963.	380679.	394112.	7.18	2.30	3.90
MANUFACTURING	4425819.	4786736.	5120042.	5263092.	5432865.	5615229.	5809649.	7.56	3.21	4.64
TRANSPORTATION & PUBLIC UTIL.	667798.	725256.	781648.	820338.	856130.	892425.	931958.	8.19	4.50	5.71
WHOLESALE & RETAIL TRADE	1024231.	1104933.	1186468.	1232326.	1282483.	1332720.	1383669.	7.63	3.92	5.14
FINANCE,INSURANCE,REAL ESTATE	806549.	868001.	919864.	970755.	1012494.	1062804.	1110738.	6.79	4.83	5.48
SERVICES	974271.	1060734.	1144601.	1202888.	1262275.	1325662.	1392425.	8.39	5.02	6.13
GROSS OUTPUT	8634670.	9331726.	9978512.	10328230.	10703268.	11107680.	11532416.	7.50	3.68	4.94
EMPLOYMENT (ACTUALS)										
AGRICULTURE,FORESTRY,FISHERIES	11872.	11837.	11800.	11518.	11241.	10968.	10700.	-0.30	-2.42	-1.72
MINING	1494.	1521.	1536.	1530.	1537.	1547.	1559.	1.41	0.36	0.71
CONSTRUCTION	18172.	19025.	19531.	19424.	19598.	19949.	20446.	3.67	1.15	1.98
MANUFACTURING	73558.	75343.	76702.	77060.	77207.	77424.	77577.	2.11	0.28	0.82
TRANSPORTATION & PUBLIC UTIL.	10550.	10729.	10895.	10927.	10942.	10947.	10961.	1.62	0.15	0.64
WHOLESALE & RETAIL TRADE	60830.	61782.	63001.	64158.	65396.	66520.	67417.	1.77	1.71	1.73
FINANCE,INSURANCE,REAL ESTATE	12651.	13406.	13680.	14620.	15054.	15857.	16280.	3.99	4.45	4.29
SERVICES	46731.	48936.	51371.	53667.	56032.	58316.	60579.	4.85	4.21	4.42
TOTAL EMPLOYMENT (JOBS)	315009.	321948.	328072.	333080.	337794.	342912.	347451.	2.05	1.45	1.65
DEMOGRAPHICS (ACTUALS)										
POPULATION: 0-14	170525.	172932.	174912.	176620.	179253.	182526.	185966.	1.28	1.54	1.46
15-34	251464.	253204.	254780.	256269.	256412.	255710.	254303.	0.66	-0.05	0.17
35-64	231554.	237172.	242005.	247518.	252942.	258809.	264877.	2.23	2.28	2.27
65+	80004.	82459.	85253.	87820.	90522.	93136.	95667.	3.23	2.92	3.02
WHITE POPULATION	538376.	546203.	553175.	560239.	566997.	573790.	580261.	1.37	1.20	1.26
NON-WHITE POPULATION	195172.	199563.	203774.	207988.	212133.	216390.	220552.	2.18	2.00	2.06
TOTAL POPULATION	733547.	745766.	756949.	768227.	779130.	790181.	800812.	1.58	1.42	1.47
CIVILIAN PERSONS EMPLOYED	299506.	306575.	312828.	317408.	321902.	326631.	330846.	2.20	1.41	1.67
CIVILIAN LABOR FORCE	321228.	329124.	336193.	341064.	345741.	350419.	354917.	2.30	1.36	1.68
UNEMPLOYED	21721.	22548.	23365.	23575.	23839.	23788.	24070.	3.72	0.75	1.73
INCOME (THOUSANDS OF 76$)										
EARNINGS BY PLACE OF RESIDENCE	3342022.	3576415.	3805120.	3968268.	4130292.	4298435.	4461273.	6.70	4.06	4.91
PROPERTY INCOME	557987.	597863.	636476.	664537.	692289.	721223.	749013.	6.80	4.15	5.03
TRANSFER PAYMENTS	869616.	936119.	1022635.	1075424.	1133252.	1179667.	1243064.	8.44	5.00	6.14
SOCIAL INSURANCE PAYMENTS	176293.	189329.	201544.	209819.	218067.	226695.	235026.	6.77	3.92	4.86
PERSONAL INCOME	4592832.	4921067.	5262687.	5498409.	5737765.	5972629.	6218323.	7.04	4.26	5.18
PERS. CONSUMPTION EXPENDITURES	3302902.	3533196.	3776314.	3940023.	4108919.	4274276.	4446990.	6.93	4.17	5.08
GROSS REGIONAL PRODUCT	5031861.	5409180.	5760375.	5966867.	6183152.	6414587.	6656952.	6.99	3.68	4.78
GOVERNMENT EXPENDITURES (THOUSANDS OF 76$)										
STATE & LOCAL GOVERNMENT	237443.	256206.	274938.	291507.	308232.	325021.	341429.	7.61	5.56	6.24
FEDERAL NON DEFENSE	1364424.	1542629.	1731652.	1891102.	2052085.	2213865.	2374577.	12.66	8.21	9.67
DEFENSE	177137.	191109.	204754.	210015.	215226.	220537.	225798.	7.51	2.48	4.13

GENREG.FORT: This program retrieves and displays forecasts of user-selected economic indicators, regions or regional aggregates and forecast years. The program is the primary analysis tool for MRMI and sample procedures for selecting data series are shown in Table 4-4. The user has several options in addition to the choice of region, economic indicator and forecast year:

- o the program will compute growth rates for all economic variables, as well as activity levels, if desired;
- o industry and regional aggregates can be retrieved from the data base; and
- o a data file of the extracted series can be created during the run for later comparative analysis runs.

Sample output from this program is shown in Table 4-5.

COMPARE.GENIND.FORT: This program reads selected indicators from the baseline and impact forecasts and displays the net impacts of the project under investigation. Two input data files are required, representing the impact and baseline files, respectively. These files must be compatible files generated, at the user's option, from identical runs of GENIND.FORT on the impact and baseline data files. The program displays net impacts (impact activity levels minus baseline activity levels) in tabular form similar to the output generated by GENIND.FORT (Table 4-6).

COMPARE.GENREG.FORT: The function of this program is similar to that of COMPARE.GENIND.FORT except that the program processes summary data generated by GENREG.FORT. The user supplies only the file names containing summary indicators from the baseline and

Table 4-4

Sample Run Procedures for Operating GENREG.FORT

```
 IS THIS A BASELINE OR IMPACT SCENARIO?
BASELINE
 INPUT REGION TYPE - COUNTY OR REGIONAL AGGREGATES
COUNTY
 INPUT NUMBER OF REGIONS TO BE PROCESSED (MAX=10)
5/
 INPUT COUNTY SEQUENCE NUMBERS ASSOCIATED WITH EACH REGION
 UP TO 10 COUNTIES CAN BE AGGREGATED TOGETHER INTO A REGION (ONE REGION PER LINE)
 SEPARATE COUNTIES IN REGION BY A SPACE OR COMMA
 AND END ALL LINES WITH A SLASH(/)
1,5,7,9/
10/
22,28,39/
12/
45,46,47/
 DO YOU WISH TO NAME ALL REGIONS?
YES
REGION 1
REGION 2
REGION 3
REGION 4
REGION 5
 INPUT NO. OF VARIABLES TO BE PROCESSED
2/
 INPUT THEIR NAMES (ONE PER LINE)
OUTPUT
EMPLOYMENT
 INPUT THE NUMBER OF INDUSTRIES OR INDUSTRY AGGREGATES TO BE PROCESSED (MAX=10)
9/
 INPUT SECTOR NUMBER(S) ASSOCIATED WITH EACH INDUSTRY OR INDUSTRY AGGREGATE.
 (MAX=50). INPUT ONE INDUSTRY PER LINE,SEPARATE SECTOR NUMBERS BY A SPACE
 OR COMMA & END ALL LINES WITH A SLASH
1 -4/
5 -9/
10 -68/
69 -72/
88 -94/
73 -75/
76 -82/
86,87/
95 -104/
 INPUT NAMES OF SECTOR OR SECTOR GROUPS (MAX 28 CHAR.)
AGRICULTURE,FOR.,FISHERIES
MINING
MANUFACTURING
PUBLIC UTILITIES
TRANSPORTATION
FINANCE,INS.,REAL ESTATE
SERVICES
CONSTRUCTION
WHOLESALE & RETAIL TRADE
 INPUT NO. OF YEARS TO BE PROCESSED AND YEARS (ALL ON ONE LINE)
 SEPARATE ENTRIES BY A SPACE OR COMMA AND END WITH A SLASH(/)
3,1980,1985,1990/
 DO YOU WANT GROWTH RATES?
YES
 DO YOU WANT A FILE SAVED FOR A COMPARISON RUN?
YES
 INPUT FILENAME
COMPARE_REGION1-5
```

Table 4-4 (Cont'd)

OPTIONS FOR THIS RUN   THU, SEP 02 1982

THIS IS A BASELINE SCENARIO AT THE COUNTY LEVEL FOR 5 REGIONS.
REGION NUMBERS ARE:

REGION NUMBER	COUNTY CODE(S)			
1	1	5	7	9
2	13			
3	22	29	39	
4	12			
5	45	46	47	

FORECASTS FOR:
OUTPUT
EMPLOYMENT
ARE BEING PROCESSED FOR THE FOLLOWING INDUSTRIES:

INDUSTRY	NAME	SECTOR NUMBERS									
1	AGRICULTURE,FOR.,FISHERIES	1	2	3	4						
2	MINING	5	6	7	8	9					
3	MANUFACTURING	10	11	12	13	14	15	16	17	18	19
		20	21	22	23	24	25	26	27	28	29
		30	31	32	33	34	35	36	37	38	39
		40	41	42	43	44	45	46	47	48	49
		50	51	52	53	54	55	56	57	58	59
		60	61	62	63	64	65	66	67	68	
4	PUBLIC UTILITIES	69	70	71	72						
5	TRANSPORTATION	88	89	90	91	92	93	94			
6	FINANCE,INS.,REAL ESTATE	73	74	75							
7	SERVICES	76	77	78	79	80	81	82			
8	CONSTRUCTION	86	87								
9	WHOLESALE & RETAIL TRADE	95	96	97	98	99	100	101	102	103	104

(INCLUDING GROWTH RATES)

THE 3 FORECAST PERIODS BEING ANALYZED ARE:

1980 1985 1990

A FILE IS BEING SAVED FOR A COMPARISON RUN
CALLED COMPARE_REGION1-5

OK?

Table 4-5

Sample Output from GENREG.FORT

COOSA RIVER NAVIGATION PROJECT MON, MAR 13 1982
KEY ECONOMIC INDICATORS

SCENARIO: BASELINE
REGION NAME: ALA AUTAUGA
REGION NUMBER: 1

VARIABLE NAME	1980	1990	1995	2000	2010	2020	2030	2039
OUTPUT (THOUSANDS OF 76$)								
AGRICULTURE,FOR.,FISHERIES	25598.	33490.	37185.	41635.	54835.	69982.	89009.	108502.
MINING	0.	0.	0.	0.	0.	0.	0.	0.
MANUFACTURING	107538.	178588.	199444.	225022.	289173.	356065.	444146.	530562.
PUBLIC UTILITIES	14150.	22598.	25614.	29000.	36959.	45429.	56383.	68369.
TRANSPORTATION	3229.	4422.	4795.	5221.	6403.	7607.	9275.	10818.
FINANCE,INS.,REAL ESTATE	4703.	6662.	7101.	6991.	7304.	7788.	8069.	8491.
SERVICES	13112.	19326.	20701.	2198.	24934.	27346.	31659.	34836.
CONSTRUCTION	11171.	18113.	18806.	20117.	24618.	29200.	36208.	42126.
WHOLESALE & RETAIL TRADE	17737.	26295.	28106.	30394.	35593.	40671.	48227.	56440.
PAYROLL (THOUSANDS OF 76$)								
AGRICULTURE,FOR.,FISHERIES	6882.	8249.	8911.	9581.	11133.	12912.	15503.	18262.
MINING	0.	0.	0.	0.	0.	0.	0.	0.
MANUFACTURING	31040.	45225.	48194.	51607.	58054.	61645.	65097.	67657.
PUBLIC UTILITIES	2683.	3538.	3706.	3950.	4457.	4997.	5663.	6626.
TRANSPORTATION	1094.	1247.	1261.	1296.	1381.	1412.	1460.	1500.
FINANCE,INS.,REAL ESTATE	2269.	3583.	4079.	4184.	4647.	5246.	5433.	6122.
SERVICES	7054.	11925.	13741.	15444.	19195.	22590.	27498.	32453.
CONSTRUCTION	6792.	12223.	13536.	15446.	20418.	26141.	34429.	44634.
WHOLESALE & RETAIL TRADE	8899.	11997.	12479.	13166.	13987.	14747.	16324.	18674.
EMPLOYMENT (JOBS)								
AGRICULTURE,FOR.,FISHERIES	902.	804.	775.	740.	702.	652.	630.	607.
MINING	0.	0.	0.	0.	0.	0.	0.	0.
MANUFACTURING	3015.	3165.	2981.	2843.	2527.	2111.	1765.	1482.
PUBLIC UTILITIES	197.	194.	185.	181.	169.	155.	143.	137.
TRANSPORTATION	57.	48.	44.	40.	35.	28.	23.	20.
FINANCE,INS.,REAL ESTATE	195.	237.	250.	246.	248.	245.	213.	190.
SERVICES	809.	1011.	1042.	1062.	1086.	1050.	1047.	1027.
CONSTRUCTION	634.	851.	858.	894.	978.	1021.	1091.	1146.
WHOLESALE & RETAIL TRADE	1382.	1378.	1308.	1266.	1125.	972.	877.	828.

Sample Output from COMPARE-GENIND.FORT

REGIONAL SUMMARIES OF KEY ECONOMIC INDICATORS IMPACT BASELINE

REGION 1: WATERWAY CORRIDOR

VARIABLE NAME	1983	1984	1985	1986	1987	1988	1989
OUTPUT (THOUSANDS OF 76$)							
AGRICULTURE,FORESTRY,FISHERIES	-0.	-0.	-1.	-5.	-10.	-11.	-8.
MINING	-0.	-0.	1.	-1.	5.	-10.	-15.
CONSTRUCTION	6244.	15697.	47800.	64554.	78670.	90187.	65176.
MANUFACTURING	-1.	18.	108.	75.	93.	22.	-435.
TRANSPORTATION & PUBLIC UTIL.	179.	321.	811.	2471.	4689.	6876.	9291.
WHOLESALE & RETAIL TRADE	437.	758.	1919.	6163.	10968.	15877.	20203.
FINANCE,INSURANCE,REAL ESTATE	404.	852.	1995.	6515.	11316.	20148.	25660.
SERVICES	580.	1026.	2613.	7906.	14459.	20195.	26372.
GROSS OUTPUT	7888.	18750.	55528.	88320.	121400.	155080.	148610.
EMPLOYMENT (ACTUALS)							
AGRICULTURE,FORESTRY,FISHERIES	-0.	0.	0.	-0.	-0.	-0.	-0.
MINING	-0.	0.	0.	0.	0.	0.	0.
CONSTRUCTION	161.	476.	1663.	2641.	3250.	3643.	2094.
MANUFACTURING	0.	1.	3.	3.	4.	3.	-3.
TRANSPORTATION & PUBLIC UTIL.	2.	4.	11.	32.	53.	70.	89.
WHOLESALE & RETAIL TRADE	34.	54.	130.	426.	732.	1040.	1250.
FINANCE,INSURANCE,REAL ESTATE	7.	14.	35.	109.	127.	264.	140.
SERVICES	23.	40.	94.	278.	541.	786.	1031.
TOTAL EMPLOYMENT (JOBS)	253.	626.	2028.	3776.	5229.	6553.	5530.
DEMOGRAPHICS (ACTUALS)							
POPULATION: 0-14	110.	255.	854.	1673.	2498.	3293.	2843.
15-34	178.	410.	1363.	2653.	3864.	4968.	4237.
35-64	177.	416.	1396.	2756.	4081.	5390.	4715.
65+	42.	109.	279.	427.	505.	592.	433.
WHITE POPULATION	393.	919.	2996.	5794.	8464.	11000.	9439.
NON WHITE POPULATION	114.	271.	897.	1715.	2484.	3243.	2789.
TOTAL POPULATION	507.	1190.	3892.	7509.	10948.	14243.	12228.
CIVILIAN PERSONS EMPLOYED	216.	533.	1762.	3373.	4774.	6032.	5067.
CIVILIAN LABOR FORCE	229.	556.	1837.	3550.	5102.	6514.	5524.
UNEMPLOYED	13.	24.	75.	177.	329.	482.	457.
INCOME (THOUSANDS OF 76$)							
EARNINGS BY PLACE OF RESIDENCE	4024.	10567.	34909.	65623.	95248.	119326.	98016.
PROPERTY INCOME	800.	2102.	6945.	13066.	18972.	23772.	19531.
TRANSFER PAYMENTS	612.	1187.	3996.	9190.	17262.	26049.	25420.
SOCIAL INSURANCE PAYMENTS	157.	402.	1347.	2686.	3946.	5290.	4951.
PERSONAL INCOME	5279.	13454.	44502.	85192.	127532.	163856.	138013.
PERS. CONSUMPTION EXPENDITURES	3884.	10032.	32501.	59312.	86604.	111515.	97672.
GROSS REGIONAL PRODUCT	7560.	18109.	53921.	83475.	112664.	141830.	132451.
GOVERNMENT EXPENDITURES (THOUSANDS OF 76$)							
STATE & LOCAL GOVERNMENT	229.	352.	897.	2935.	5662.	8586.	11123.
FEDERAL NON DEFENSE	810.	1317.	3509.	11882.	23869.	17163.	50079.
DEFENSE	0.	0.	0.	0.	0.	0.	0.

impact forecasts. The net impacts for those regions and sectors analyzed by GENREG.FORT are then displayed in a table similar to that produced by that program (Table 4-7).

For specialized evaluation needs that cannot be handled by these programs, othe software must be developed to retrieve and display or analzye selected series. However, as the structure is identical for all regions such that variables can be located easily, the retrieval of data is straightforward and should cause no problem to users with some programming experience. Source code for analysis programs described in this section is given in Section 4.4.

4.4 Source Code for Analysis Programs

Table 4-7
Sample Output from COMPARE-GENREG.FORT

COOSA RIVER NAVIGATION PROJECT SUN. MAR 14 1982
KEY ECONOMIC INDICATORS

REGION NAME: ALA TALLADEGA

VARIABLE NAME	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
OUTPUT (THOUSANDS OF 76$)										
AGRICULTURE,FOR.,FISHERIES	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-1.	-1.	-1.
MINING	0.	-0.	-0.	0.	1.	1.	1.	-0.	-1.	-0.
MANUFACTURING	-3.	-8.	-9.	-10.	-6.	-1.	-13.	-42.	-66.	-31.
PUBLIC UTILITIES	6.	14.	25.	34.	29.	51.	228.	748.	1571.	1019.
TRANSPORTATION	3.	7.	11.	10.	6.	17.	87.	275.	502.	467.
FINANCE,INS.,REAL ESTATE	44.	57.	83.	90.	110.	270.	1188.	4683.	6096.	9297.
SERVICES	30.	83.	141.	136.	119.	195.	1150.	3512.	7217.	7532.
CONSTRUCTION	519.	611.	42.	27.	1611.	7677.	21477.	30500.	19395.	3572.
WHOLESALE & RETAIL TRADE	22.	61.	99.	86.	50.	144.	738.	2295.	4056.	3903.
PAYROLL (THOUSANDS OF 76$)										
AGRICULTURE,FOR.,FISHERIES	-0.	-0.	-0.	-0.	0.	0.	-0.	-0.	-0.	-0.
MINING	0.	-0.	-0.	0.	0.	0.	0.	0.	-0.	-0.
MANUFACTURING	-0.	-3.	-4.	-4.	-1.	2.	-0.	-5.	-10.	-4.
PUBLIC UTILITIES	3.	5.	8.	8.	6.	16.	79.	240.	449.	437.
TRANSPORTATION	1.	2.	3.	3.	2.	4.	21.	69.	133.	155.
FINANCE,INS.,REAL ESTATE	9.	16.	26.	25.	23.	50.	171.	1632.	-417.	2495.
SERVICES	14.	36.	68.	77.	74.	86.	516.	1634.	3701.	4322.
CONSTRUCTION	269.	394.	215.	22.	605.	3559.	10412.	15165.	11264.	2290.
WHOLESALE & RETAIL TRADE	19.	47.	76.	61.	33.	113.	588.	1811.	3114.	2020.
EMPLOYMENT (JOBS)										
AGRICULTURE,FOR.,FISHERIES	-0.	-0.	0.	-0.	0.	0.	0.	-0.	-0.	-0.
MINING	0.	0.	0.	0.	0.	0.	0.	0.	-0.	-0.
MANUFACTURING	-0.	-0.	-0.	-0.	-0.	0.	-0.	-0.	-1.	-0.
PUBLIC UTILITIES	0.	0.	0.	0.	0.	1.	3.	8.	16.	15.
TRANSPORTATION	0.	0.	0.	0.	0.	0.	1.	3.	6.	7.
FINANCE,INS.,REAL ESTATE	1.	1.	1.	1.	1.	3.	9.	80.	-18.	126.
SERVICES	1.	3.	6.	6.	5.	7.	38.	117.	251.	203.
CONSTRUCTION	17.	23.	12.	1.	31.	243.	715.	954.	574.	4.
WHOLESALE & RETAIL TRADE	3.	6.	8.	6.	3.	12.	59.	176.	208.	241.

**** STOP
OK,

```
      PARAMETER NYEAR=7
      REAL*4 NAME
      INTEGER*4 NWORD
      COMMON/REGDAT/REGAGG(4,39,7),REG(39,7)
      COMMON/GROWTH/GRO(38,3),IDATE(3,2)
      COMMON/INDAT/IYR,IDC(5),NAME(9),AREA,FAC,USC(1445)
      COMMON/GRP/VACOEF(104)
      COMMON/NAMES/RNAM(4,8),SECNAM(38,8)
      DIMENSION INUM(10,3)
      DATA REGAGG/1092*0./
      DATA INUM/1,8,11,19,26,28,51,58,59,61,
     *2,49,296,310,339,350,359,1402,0,0,
     *9999,0,0,0,0,0,0,0,0,0/
      CALL DEFILE(8,'URBSYS>PERRIE>NAMER,',0,0,0)
      CALL DEFILE(9,'URBSYS>PERRIE>VALUE_ADDED,',0,0,0)
      CALL ATRAN(11,41,'HARRIS>ALA>ALA83,',0,0)
      CALL ATRAN(12,41,'HARRIS>ALA>ALA84,',0,0)
      CALL ATRAN(13,41,'HARRIS>ALA>ALA85,',0,0)
      CALL ATRAN(14,41,'HARRIS>ALA>ALA86,',0,0)
      CALL ATRAN(15,41,'HARRIS>ALA>ALA87,',0,0)
      CALL ATRAN(16,41,'HARRIS>ALA>ALA88,',0,0)
      CALL ATRAN(17,41,'HARRIS>ALA>ALA89,',0,0)
      CALL DEFILE(19,'URBSYS>KEY_SERIES_BASE_MAR10.CPER,',0,20,0)
      CALL DEFILE(18,'URBSYS>BASE_REPORT.MAR10.CPER,',0,20,0)
      NWORD=LOC(USC(1445))-LOC(IYR)+2
      READ(8,100)((RNAM(I,J),J=1,8),I=1,4)
  100 FORMAT(8A4)
      READ(8,100)((SECNAM(I,J),J=1,8),I=1,38)
      READ(9,101) VACOEF
  101 FORMAT(5F10.0)
C
C     PROCESS REGIONAL DATA
C
      DO 1 ICNTY=1,74
      NU=10
      IFLAG=1
C
C     ZERO OUT BUFFER
C
      DO 5 J=1,7
      DO 5 I=1,39
      REG(I,J)=0.
    5 CONTINUE
C
C     READ COUNTY DATA FOR ALL FORECAST YEARS
C
      DO 10 I=1,NYEAR
      NUMYR=I
      NU=NU+1
      ICHK=-1
      CALL ATRAN(NU,2,NWORD,IYR,ICHK)
C
C     AGGREGATE SECTOR DETAIL
C
      CALL AGGSEC(NUMYR,NYEAR)
C
C     AGGREGATE TO REGIONS
C
      IF(IFLAG.LT.0) GO TO 18
      IFLAG=-1
      DO 15 K=1,3
```

```
      IF(INUM(J,K).EQ.0) GO TO 15
      IF(IDC(1).EQ.INUM(J,K)) GO TO 17
 16   CONTINUE
 15   CONTINUE
      K=4
 17   CONTINUE
      NR=K
 18   CONTINUE
      CALL AGGREG(NUMYR,NYEAR,NR)
 10   CONTINUE
 1    CONTINUE
      DO 20 NR=1,4
      CALL REPORT(NYEAR,NR)
      DO 30 I=1,38
      WRITE(19,200)(REGAGG(NR,I,J),J=1,7),(GRO(I,J),J=1,3)
 200  FORMAT(5E13.7)
 30   CONTINUE
 20   CONTINUE
      CALL DEFILE(0,0,0,0,0)
      CALL ATRAN(99,99,0,0,0)
      STOP
      END
      SUBROUTINE AGGREG(IK,NYEAR,NR)
      COMMON/REGDAT/REGAGG(4,39,7),REG(39,7)
      SCALE=1.
      IF(NR.EQ.3) SCALE=1000.
      DO 5 I=1,38
      REGAGG(NR,I,IK)=REGAGG(NR,I,IK)+REG(I,IK)/SCALE
 5    CONTINUE
      REGAGG(NR,39,IK)=REG(39,IK)
      RETURN
      END
      SUBROUTINE AGGSEC(IK,NYEAR)
      REAL*4 NAME
      INTEGER*2 FSEC,LSEC
      COMMON/INDAT/IYR,IDC(5),NAME(9),AREA,FAC,USC(1445)
      COMMON/REGDAT/REGAGG(4,39,7),REG(39,7)
      COMMON/GRP/VACOEF(104)
      DIMENSION FSEC(8),LSEC(8),COMP(4)
      DATA FSEC/1,5,86,10,88,95,73,76/,
     *LSEC/4,9,87,68,94,104,75,82/
      DATA COMP/1.0082735,1.16281,1.185638,1.0396984/
C
C     AGGREGATE OUTPUT & EMPLOYMENT TO 8 MAJOR SECTORS
C
      DO 5 I=1,8
      K1=FSEC(I)
      K2=LSEC(I)
      DO 10 J=K1,K2
      REG(I,IK)=REG(I,IK)+USC(J)
      REG(I+9,IK)=REG(I+9,IK)+USC(J+239)
 10   CONTINUE
 5    CONTINUE
      REG(9,IK)=USC(105)
      REG(18,IK)=USC(348)
C
C     ADD PUBLIC UTILITIES TO TRANSPORTATION
C
      DO 11 J=69,72
      REG(5,IK)=REG(5,IK)+USC(J)
      REG(14,IK)=REG(14,IK)+USC(J+239)
 11   CONTINUE
C
C     AGGREGATE POPULATION TO AGE COHORTS & RACE COHORTS
C
      DO 15 J=1,4
```

```
      I=18+J
      REG(I,IK)=USC(J+220)+USC(J+224)
      REG(23,IK)=REG(23,IK)+USC(J+220)
      REG(24,IK)=REG(24,IK)+USC(J+224)
 15   CONTINUE
      REG(25,IK)=REG(23,IK)+REG(24,IK)
      REG(26,IK)=USC(352)
      REG(27,IK)=USC(353)
      REG(28,IK)=USC(354)
      DO 20 I=1,5
      REG(I+28,IK)=USC(I+215)
 20   CONTINUE
      REG(34,IK)=USC(459)
      REG(36,IK)=USC(1038)
      REG(37,IK)=USC(1039)
      REG(38,IK)=USC(564)
      REG(39,IK)=FLOAT(IYR)
C
C     CALCULATE GROSS REGIONAL PRODUCT
C
      DO 25 I=1,104
      REG(35,IK)=REG(35,IK)+USC(I)*VACOEF(I)
 25   CONTINUE
      DO 26 I=1,4
      K=104+I
      REG(35,IK)=REG(35,IK)+COMP(I)*USC(105+K)
 26   CONTINUE
      RETURN
      END
      SUBROUTINE REPORT(NYEAR,NR)
      REAL*8 THOUS,AMILL,ACTUAL,DOLLAR,DEMOG
      COMMON/REGDAT/REGAGG(4,39,7),ST(39,7)
      COMMON/NAMES/RNAM(4,8),SECNAM(38,8)
      COMMON/GROWTH/GRO(38,3),IDATE(3,2)
      DIMENSION LYEAR(7),IISEC(3)
      DATA IISEC/1,3,7/
      DATA THOUS/'THOUSAND'/,AMILL/' MILLION'/,
     *ACTUAL/'  ACTUAL'/
      DO 1 J=1,7
      DO 1 K=1,39
      ST(K,J)=REGAGG(NR,K,J)
 1    CONTINUE
      DOLLAR=THOUS
      DEMOG=ACTUAL
      IF(NR.NE.3) GO TO 2
      DOLLAR=AMILL
      DEMOG=THOUS
 2    CONTINUE
C
C     CALCULATE ANNUAL GROWTH RATES FOR SELECTED YEARS
C
      CALL RATER(IISEC)
C
C     WRITE OUT HEADERS FOR REGIONAL SUMMARIES
C
      WRITE(18,200)
 200  FORMAT(///,46X,'REGIONAL SUMMARIES OF KEY ECONOMIC INDICATORS',
     *6X,'BASELINE SCENARIO',/,46X,45('-'))
      WRITE(18,201)(RNAM(NR,J),J=1,8)
 201  FORMAT(53X,8A4)
      DO 10 I=1,NYEAR
      LYEAR(I)=IFIX(ST(39,I))
 10   CONTINUE
      WRITE(18,211)
 211  FORMAT(104X,'ANNUAL GROWTH RATES(%)')
```

```
202  FORMAT(9X,'VARIABLE NAME',10X,7(6X,I4),3(2X,I2,'-',I2,2X),
    */,9X,13('-'),10X,7(6X,4('-')),3(2X,5('-'),2X))
     WRITE(18,203) DOLLAR
203  FORMAT(' OUTPUT (',A8,'S OF 76$)')
     DO 15 I=1,9
     WRITE(18,204)(SECNAM(I,J),J=1,8),(ST(I,J),J=1,7),
    *(GRO(I,J),J=1,3)
204  FORMAT(1X,8A4,7F10.0,3(F6.2,3X))
15   CONTINUE
     WRITE(18,209) DEMOG
209  FORMAT(/,' EMPLOYMENT (',A8,'S)')
     DO 16 I=10,18
     WRITE(18,204)(SECNAM(I,J),J=1,8),(ST(I,J),J=1,7),
    *(GRO(I,J),J=1,3)
16   CONTINUE
     WRITE(18,205) DEMOG
205  FORMAT(/,' DEMOGRAPHICS (',A8,'S)')
     DO 17 I=19,28
     WRITE(18,204)(SECNAM(I,J),J=1,8),(ST(I,J),J=1,7),
    *(GRO(I,J),J=1,3)
17   CONTINUE
     WRITE(18,206) DOLLAR
206  FORMAT(/,' INCOME (',A8,'S OF 76$)')
     DO 18 I=29,35
     WRITE(18,204)(SECNAM(I,J),J=1,8),(ST(I,J),J=1,7),
    *(GRO(I,J),J=1,3)
18   CONTINUE
     WRITE(18,207) DOLLAR
207  FORMAT(/,' GOVERNMENT EXPENDITURES',/,
    *3X,'(',A8,'S OF 76$)')
     DO 19 I=36,38
     WRITE(18,204)(SECNAM(I,J),J=1,8),(ST(I,J),J=1,7),
    *(GRO(I,J),J=1,3)
19   CONTINUE
     WRITE(18,199)
199  FORMAT(//)
C
C    ZERO OUT ST-MATRIX BEFORE NEXT USE
C
     DO 25 J=1,7
     DO 26 I=1,39
     ST(I,J)=0.
26   CONTINUE
25   CONTINUE
     RETURN
     END
     SUBROUTINE RATER(ISEC)
     INTEGER*2 CENT20,CENT21,CENT
     COMMON/REGDAT/REGAGG(4,39,7),ST(39,7)
     COMMON/GROWTH/GRO(38,3),IDATE(3,2)
     DIMENSION ISEC(3)
     DATA CENT20/1900/,CENT21/2000/
     N=-1
     DO 10 I=1,2
     K=I+1
     M=N+I
     DO 11 J=K,3
     M=M+(J-I)
     JJ=ISEC(J)
     II=ISEC(I)
     YEAR=ST(39,JJ)-ST(39,II)
     YEAR=1./YEAR
     CENT=CENT20
     IF(IFIX(ST(39,II)).GT.1999) CENT=CENT21
     IDATE(M,1)=IFIX(ST(39,II))-CENT
```

```
      IDATE(M,2)=IFIX(ST(39,JJ))-CENT
      DO 12 L=1,38
      GRO(L,M)=0.
      IF(ST(L,II).NE.0.) GRO(L,M)=100.*(((ST(L,JJ)/ST(L,II))
     ***YEAR)-1.)
 12   CONTINUE
 11   CONTINUE
 10   CONTINUE
      RETURN
      END
OK,
```

```
      REAL*4 NAME
      INTEGER*2 ENDER,FLAG,FSAV,REGREG,FYEAR,CENMAP,RTRACK
      INTEGER*4 NWORD
      COMMON/PARAM/KODE,NUMREG,NECIND,IGROUP,BLANK,ISTOP,
     *ENDER,SCALE,IFGRO,MULTI,ISCEN,FLAG,FSAV
      COMMON/NAMES/SECNAM(3,11),GRPNAM(10,7),REGNAM(10,9),
     *CENNAM(9,4),INDEX(11),INDER(3)
      COMMON/AREAS/ICODE(10,10),REGREG(10),KNTREG(10)
      COMMON/INDUS/LGROUP(10,60),NLGRP(10),IND104(3)
      COMMON/YEARS/NUMYR,IYEAR(10),YEAR(10),FYEAR(10),
     *LYEAR(10),NYEARS
      COMMON/INDAT/IYR,IDC(5),NAME(9),AREA,FAC,USC(1445)
      COMMON/MAPS/CENMAP(10,3),RTRACK(10)
      COMMON/REGOUT/RVAR(10,30,10)
      COMMON/FORMS/FORM(63),FORGRO(63),RTYPE(20),DATER(4)
      DATA INDEX/2,2,3,1,2,3,3,3*2,3/
      DATA CENMAP/1,8,11,19,26,29,51,58,59,61,
     *2,49,296,310,339,350,359,1402,0,0,
     *9999,9*0/
      DATA CENNAM/'REGI','ON 1',': WA','TERW','AY C','ORRI',
     *'DOR ','    ','    ','REGI','ON 2',': MA','JOR ','TRAD',
     *'ING ','PART','NERS','    ','REGI','ON 3',': RE','ST O',
     *'F UN','ITED',' STA','TES ','    ','REGI','ON 4',': RE',
     *'ST O','F AL','ABAM','A   ','    ','    '/
      DATA BLANK/'    '/,IFGRO/1/,ISTOP/0/,ENDER/0/,
     *SCALE/1./,ISCEN/-1/
      DATA ICODE/100*0/,RTRACK/10*0/,RVAR/3000*0./,
     *LGROUP/600*0/
      NWORD=LOC(USC(1445))-LOC(IYR)+2
      CALL ATTDEV(1,1,1,66)
      CALL SETUP(INDREG)
      MULTI=NUMYR*NECIND*IGROUP
      DO 1 I=1,74
      KODE=0
      IF(ENDER.GE.NUMREG) GO TO 50
      DO 10 IY=1,NUMYR
      NU=10+IY
      ICHK=-1
      CALL ATRAN(NU,2,NWORD,IYR,ICHK)
      IF(KODE)10,20,11
20    CONTINUE
      CALL REGCHK(INDREG,IREG)
      IF(KODE)10,10,11
11    CONTINUE
      CALL AGGSEC(INDREG,IREG,IY)
10    CONTINUE
1     CONTINUE
50    CONTINUE
      ISTOP=1
      DO 61 I=1,10
      IF(RTRACK(I).EQ.0) GO TO 61
      MAPREG=RTRACK(I)
      INT=I
      IF(KNTREG(MAPREG).GT.0) CALL ERRCDE(7,MAPREG)
      CALL REPORT(MAPREG,INT,INDREG)
61    CONTINUE
      CALL ATRAN(99,99,0,0,0)
      CALL DEFILE(0,0,0,0,0)
      STOP
      END
      SUBROUTINE SETUP(INDREG)
```

```
     *CENMAP,RTRACK
      REAL*8 XDAT
      COMMON/PARAM/KODE,NUMREG,NECIND,IGROUP,BLANK,ISTOP,
     *ENDER,SCALE,IFGRO,MULTI,ISCEN,FLAG,FSAV
      COMMON/NAMES/SECNAM(3,11),GRPNAM(10,7),REGNAM(10,9),
     *CENNAM(9,4),INDEX(11),INDER(3)
      COMMON/FORMS/FORM(63),FORGRO(63),RTYPE(2),DATER(4)
      COMMON/AREAS/ICODE(10,10),REGREG(10),KNTREG(10)
      COMMON/INDUS/LGROUP(10,60),NLGRP(10),IND104(3)
      COMMON/YEARS/NUMYR,IYEAR(10),YEAR(10),FYEAR(10),
     *LYEAR(10),NYEARS
      COMMON/MAPS/CENMAP(10,3),RTRACK(10)
      DIMENSION SEC(11),INDSEC(11),UNITS(8,6),HEAD0(2),
     *HEAD1(12),HEAD2(7,2),HEAD3(7,2),CTYPE(2),FNAM(20)
      DATA CENT20/1900/,CENT21/2000/,ANS/'NO'/,BASE/'BASE'/,
     *COUNTY/'COUN'/
      DATA SEC/'OUTP','PAYR','EMPL','PCE ','DEFE','EQUI',
     *'CONS','EXPO','IMPO','DEMA','KEY '/
      DATA INDSEC/0,105,239,354,459,564,638,802,907,
     *1116,0/
      DATA UNITS/'(THO','USAN','DS O','F 76','$)  ','    ',
     *'    ','    ','(MIL','LION','S OF',' 76$',')   ','    ',
     *'    ','    ','(JOB','S)  ','    ','    ','    ','    ',
     *'    ','    ','(THO','USAN','DS O','F JO','BS) ','    ',
     *'    ','    ','(THO','USAN','DS O','F 76','$ & ','ACTU',
     *'ALS ','    ','(MIL','LION','S OF',' 76$',' & T','HOUS',
     *'ANDS',')   '/
      DATA HEAD0/'(///',','''  '/
      DATA HEAD1/'  CO','OSA ','RIVE','R NA','VIGA','TION',
     *' PRO','JECT',' '',5','X,4A','4,/,',','''   '/
      DATA HEAD2/'KEY ','ECON','OMIC',' IND','ICAT','ORS''',
     *',/,''','   -','----','----','----','----','----',
     *'--'')'/
      DATA HEAD3/'  AN','NUAL',' GRO','WTH ','RATE','S  ''',
     *',/,''','  --','----','----','----','----',
     *'-  ''',')   '/
      DATA NAMEF/1/,ERROR/'ZZZZ'/,A/'A'/,FSAV/1/
      XDAT=DATE$A(DATER)
      CALL DATE$A(DATER)
      INDREG=1
C
      WRITE(1,200)
  200 FORMAT(' IS THIS A BASELINE OR IMPACT SCENARIO?')
      READ(1,99) RTYPE
   99 FORMAT(2A4)
      IF(RTYPE(1).EQ.BASE) ISCEN=1
C
  100 FORMAT(A4)
      WRITE(1,201)
  201 FORMAT(' INPUT REGION TYPE - COUNTY OR REGIONAL AGGREGATES')
      READ(1,99) CTYPE
      KSCALE=1
      IF(CTYPE(1).NE.COUNTY) INDREG=2
      IF(INDREG.LT.2) GO TO 50
      KSCALE=1
      SCALE=1.
      NUMREG=4
      NREG=NUMREG-1
      DO 60 I=1,NREG
      DO 61 J=1,10
      IF(CENMAP(J,I).EQ.0) GO TO 62
      ICODE(I,J)=CENMAP(J,I)
   61 CONTINUE
      J=11
   62 CONTINUE
```

```
60    CONTINUE
      REGREG(4)=55
      ICODE(4,1)=-99
      DO 63 I=1,NUMREG
      KNTREG(I)=REGREG(I)
      DO 64 J=1,9
      REGNAM(I,J)=CENNAM(J,I)
64    CONTINUE
      REGREG(I)=-REGREG(I)
63    CONTINUE
      GO TO 2
50    CONTINUE
301   CONTINUE
      FLAG=1
      WRITE(1,202)
202   FORMAT(' INPUT NUMBER OF REGIONS TO BE PROCESSED (MAX=10)')
      READ(1,*) NUMREG
      KPASS=NUMREG
      IF(NUMREG.GT.10) CALL ERRCDE(1,KPASS)
      IF(FLAG.LT.0) GO TO 301
      WRITE(1,203)
203   FORMAT(' INPUT COUNTY SEQUENCE NUMBERS ASSOCIATED WITH ',
     *'EACH REGION',/,' UP TO 10 COUNTIES CAN BE AGGREGATED TOGETHER ',
     *'INTO A REGION (ONE REGION PER LINE)',/,
     *' SEPARATE COUNTIES IN REGION BY A SPACE OR COMMA ',/,
     *' AND END ALL LINES WITH A SLASH(/)')
      DO 10 I=1,NUMREG
      READ(1,*)(ICODE(I,J),J=1,10)
      DO 11 J=1,10
      IF(ICODE(I,J).LT.0) GO TO 301
      IF(ICODE(I,J).EQ.0) GO TO 15
11    CONTINUE
      J=11
15    CONTINUE
      REGREG(I)=J-1
      KNTREG(I)=REGREG(I)
10    CONTINUE
C
302   CONTINUE
      WRITE(1,204)
204   FORMAT(' DO YOU WISH TO NAME ALL REGIONS?')
      READ(1,100) ANSWER
      IF(ANSWER.NE.ANS) GO TO 65
      NAMEF=-1
      DO 92 I=1,NUMREG
      IF(REGREG(I).EQ.1) GO TO 92
      GO TO 66
92    CONTINUE
      GO TO 65
66    CONTINUE
      WRITE(1,205)
205   FORMAT(' INPUT NAME OF COUNTY AGGREGATES. ',/,
     *' SINGLE COUNTY REGIONS WILL BE NAMED AUTOMATICALLY')
65    CONTINUE
      DO 12 I=1,NUMREG
      IF(NAMEF.GT.0) GO TO 67
      IF(REGREG(I).EQ.1) GO TO 12
67    CONTINUE
      READ(1,101)(REGNAM(I,J),J=1,9)
101   FORMAT(9A4)
      DO 68 J=1,9
      IF(REGNAM(I,J).EQ.ERROR) GO TO 302
68    CONTINUE
      REGREG(I)=-REGREG(I)
12    CONTINUE
```

```
C
 303  CONTINUE
      FLAG=1
      WRITE(1,206)
 206  FORMAT(' INPUT NO. OF VARIABLES TO BE PROCESSED')
      READ(1,*) NECIND
      WRITE(1,207)
 207  FORMAT(' INPUT THEIR NAMES (ONE PER LINE)')
      DO 3 I=1,NECIND
 307  CONTINUE
      FLAG=1
      DO 6 J=1,11
      SECNAM(I,J)=BLANK
 6    CONTINUE
      READ(1,102)(SECNAM(I,J),J=1,3)
 102  FORMAT(3A4)
      DO 4 J=1,11
      IF(SECNAM(I,1).EQ.SEC(J)) GO TO 8
 4    CONTINUE
      CALL ERRCDE(2,I)
      IF(FLAG.LT.0) GO TO 307
 8    CONTINUE
      IND104(I)=INDSEC(J)
      INDER(I)=INDEX(J)
      L=INDEX(J)
      IF(NECIND.LT.2) GO TO 69
      IF(SECNAM(I,1).EQ.SEC(6).OR.SECNAM(I,1).EQ.SEC(7)
     *.OR.SECNAM(I,1).EQ.SEC(11)) CALL ERRCDE(3,I)
      IF(FLAG.LT.0) GO TO 303
 69   CONTINUE
      DO 9 K=1,8
      SECNAM(I,K+L)=UNITS(K,KSCALE)
 9    CONTINUE
      IF(J.NE.3) GO TO 19
      DO 18 K=1,8
      SECNAM(I,K+L)=UNITS(K,KSCALE+2)
 18   CONTINUE
 19   CONTINUE
      IF(J.NE.11) GO TO 3
      DO 27 K=1,8
      SECNAM(I,K+L)=UNITS(K,KSCALE+4)
 27   CONTINUE
 3    CONTINUE
C
 304  CONTINUE
      FLAG=1
      WRITE(1,208)
 208  FORMAT(' INPUT THE NUMBER OF INDUSTRIES OR INDUSTRY',
     *' AGGREGATES TO BE PROCESSED (MAX=10)')
      READ(1,*) IGROUP
      KPASS=IGROUP
      IF(IGROUP.GT.10) CALL ERRCDE(4,KPASS)
      IF(FLAG.LT.0) GO TO 304
C
      WRITE(1,209)
 209  FORMAT(' INPUT SECTOR NUMBER(S) ASSOCIATED WITH EACH',
     *' INDUSTRY OR INDUSTRY AGGREGATE,',/,' (MAX=60).',
     *' INPUT ONE INDUSTRY PER LINE,SEPARATE SECTOR NUMBERS',
     *' BY A SPACE',/,' OR COMMA & END ALL LINES WITH A SLASH')
      DO 5 I=1,IGROUP
      READ(1,*)(LGROUP(I,J),J=1,60)
      DO 70 J=1,60
      IF(LGROUP(I,J).EQ.-1) GO TO 304
 70   CONTINUE
      KPASS=NLGRP(I)
      CALL EXPAND(I,KPASS)
```

```
      NLGRP(I)=KPASS-1
 5    CONTINUE
C
 305  CONTINUE
      WRITE(1,210)
 210  FORMAT(' INPUT NAMES OF SECTOR OR SECTOR GROUPS (MAX 28 CHAR.)')
      DO 7 I=1,IGROUP
      READ(1,103)(GRPNAM(I,J),J=1,7)
 103  FORMAT(7A4)
      DO 71 J=1,7
      IF(GRPNAM(I,J).EQ.ERROR) GO TO 305
 71   CONTINUE
 7    CONTINUE
C
 306  CONTINUE
      FLAG=1
      WRITE(1,211)
 211  FORMAT(' INPUT NO. OF YEARS TO BE PROCESSED AND YEARS ',
     *'(ALL ON ONE LINE)',/,' SEPARATE ENTRIES BY A SPACE OR ',
     *'COMMA AND END WITH A SLASH(/)')
      READ(1,*) NUMYR,(IYEAR(I),I=1,NUMYR)
      KPASS=NUMYR
      IF(NUMYR.GT.10) CALL ERRCDE(5,KPASS)
      IF(FLAG.LT.0) GO TO 306
      DO 72 I=1,10
      IF(IYEAR(I).EQ.0) GO TO 73
 72   CONTINUE
      GO TO 74
 73   CONTINUE
      K=I-1
      IF(K.NE.NUMYR) CALL ERRCDE(6,I)
      IF(FLAG.LT.0) GO TO 306
 74   CONTINUE
C
      CALL OPENF
C
      DO 20 I=1,63
      FORM(I)=BLANK
      FORGRO(I)=BLANK
 20   CONTINUE
      K=0
      DO 21 I=1,7
      K=K+1
      FORM(K)=HEAD0(I)
      FORGRO(K)=HEAD0(I)
 21   CONTINUE
      L=NUMYR+1
      DO 22 I=1,L
      K=K+1
      FORM(K)=BLANK
      FORGRO(K)=BLANK
 22   CONTINUE
      DO 23 I=1,12
      K=K+1
      FORM(K)=HEAD1(I)
      FORGRO(K)=HEAD1(I
 23   CONTINUE
      L=NUMYR+2
      DO 24 J=1,2
      DO 25 I=1,L
      K=K+1
      FORM(K)=BLANK
      FORGRO(K)=BLANK
 25   CONTINUE
      DO 26 I=1,7
```

```
      FORM(K)=HEAD2(I,J)
      FORGRO(K)=HEAD3(I,J)
 26   CONTINUE
 24   CONTINUE
C
      WRITE(1,212)
 212  FORMAT(' DO YOU WANT GROWTH RATES?')
      READ(1,100) ANSWER
      IF(ANSWER.EQ.ANS) GO TO 40
      IFGRO=-IFGRO
      NYEARS=NUMYR-1
      DO 30 I=1,NYEARS
      CENT=CENT20
      IF(IYEAR(I).GT.1999) CENT=CENT21
      FYEAR(I)=IYEAR(I)-CENT
      IF(IYEAR(I+1).GT.1999) CENT=CENT21
      LYEAR(I)=IYEAR(I+1)-CENT
      YEAR(I)=1./FLOAT(IYEAR(I+1)-IYEAR(I))
 30   CONTINUE
      CENT=CENT20
      IF(IYEAR(1).GT.1999) CENT=CENT21
      FYEAR(NUMYR)=IYEAR(1)-CENT
      IF(IYEAR(NUMYR).GT.1999) CENT=CENT21
      LYEAR(NUMYR)=IYEAR(NUMYR)-CENT
      YEAR(NUMYR)=1./FLOAT(IYEAR(NUMYR)-IYEAR(1))
C
 40   CONTINUE
      WRITE(1,213)
 213  FORMAT(' DO YOU WANT A FILE SAVED FOR A COMPARISON RUN?')
      READ(1,100) ANSWER
      IF(ANSWER.EQ.ANS) GO TO 80
      FSAV=-1
      WRITE(1,214)
 214  FORMAT(' INPUT FILENAME')
      READ(1,104) FNAM
 104  FORMAT(20A4)
      CALL DEFILE(7,FNAM,80,20,0)
      WRITE(7) NUMYR,NUMREG,NECIND,IGROUP
      WRITE(7) (IYEAR(J),J=1,NUMYR)
      DO 90 I=1,NECIND
      WRITE(7)(SECNAM(I,J),J=1,11)
 90   CONTINUE
      DO 91 I=1,IGROUP
      WRITE(7)(GRPNAM(I,J),J=1,7)
 91   CONTINUE
 80   CONTINUE
      WRITE(1,215) DATER
 215  FORMAT(//,30X,'OPTIONS FOR THIS RUN',5X,4A4,/,30X,20('-'))
      WRITE(1,216) RTYPE,CTYPE,NUMREG
 216  FORMAT(/,'THIS IS A ',2A4,' SCENARIO AT THE ',
     *A4,A2,' LEVEL FOR ',I2,' REGIONS.',/,
     *'REGION NUMBERS ARE:',//,8X,'REGION NUMBER',
     *3X,'COUNTY CODE(S)',/,8X,13('-'),3X,14('-'))
      DO 81 I=1,NUMREG
      IF(I.EQ.4.AND.INDREG.GT.1) GO TO 82
      K=KNTREG(I)
      WRITE(1,217)I,(ICODE(I,J),J=1,K)
 217  FORMAT(12X,I3,9X,10I5)
      GO TO 81
 82   CONTINUE
      WRITE(1,218) I
 218  FORMAT(12X,I3,9X,'ALL OTHER COUNTIES')
 81   CONTINUE
      WRITE(1,219)
 219  FORMAT(/,'FORECASTS FOR:')
```

AD-A150 318 REGIONAL DEVELOPMENT IMPACTS MULTI-REGIONAL - MULTI-INDUSTRY MODEL (MRMI)..(U) OKLAHOMA UNIV NORMAN CENTER FOR ECONOMIC AND BUSINESS RESEARC.. 2/3

UNCLASSIFIED P D HALL ET AL. SEP 82 IWR-84-UM-2 F/G 13/2 NL

1.0
2.8
2.5
4.5
5.0
5.6
6.3
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

```
      K=INDER(I)
      WRITE(1,220)(SECNAM(I,J),J=1,K)
220   FORMAT(3(14X,3A4))
83    CONTINUE
      WRITE(1,221)
221   FORMAT('ARE BEING PROCESSED FOR THE FOLLOWING INDUSTRIES:')
      WRITE(1,222)
222   FORMAT(/,2X,'INDUSTRY',14X,'NAME',16X,'SECTOR NUMBERS',/,
     *2X,8('-'),14X,4('-'),16X,14('-'))
      DO 84 I=1,IGROUP
      K=NLGRP(I)
      IF(K.GT.10) GO TO 85
      WRITE(1,223) I,(GRPNAM(I,J),J=1,7),(LGROUP(I,J),J=1,K)
223   FORMAT(5X,I3,5X,7A4,10I4)
      GO TO 84
85    CONTINUE
      WRITE(1,223) I,(GRPNAM(I,J),J=1,7),(LGROUP(I,J),J=1,10)
      WRITE(1,224) (LGROUP(I,J),J=11,K)
224   FORMAT(41X,10I4)
84    CONTINUE
      IF(IFGRO.GT.0) GO TO 86
      WRITE(1,225)
225   FORMAT(/,'(INCLUDING GROWTH RATES)')
86    CONTINUE
      WRITE(1,226) NUMYR,(IYEAR(I),I=1,NUMYR)
226   FORMAT(/,'THE ',I2,' FORECAST PERIODS BEING ANALYZED ARE:',
     *//,10I5)
      IF(ANSWER.EQ.ANS) GO TO 87
      ANSWER=A
      WRITE(1,227) ANSWER
227   FORMAT(/,A2,' FILE IS BEING SAVED FOR A COMPARISON RUN')
      WRITE(1,228)(FNAM(I),I=1,18)
228   FORMAT('CALLED ',18A4)
      GO TO 88
87    CONTINUE
      WRITE(1,227) ANSWER
88    CONTINUE
      WRITE(1,231)
231   FORMAT(//,'OK?',//)
      READ(1,100) ANSWER
      IF(ANSWER.NE.ANS) GO TO 89
      WRITE(1,229)
229   FORMAT(/,'WAY TO GO, HOSEHEAD!')
      CALL ATRAN(99,99,0,0,0)
      CALL DEFILE(0,0,0,0,0)
      STOP
89    CONTINUE
      WRITE(1,230)
230   FORMAT(/,'OK - PROCESSING BEGINS')
      RETURN
      END
      SUBROUTINE ERRCDE(N,K)
      INTEGER*2 ENDER,FLAG,FSAV
      COMMON/PARAM/KODE,NUMREG,NECIND,IGROUP,BLANK,ISTOP,
     *ENDER,SCALE,IFGRO,MULTI,ISCEN,FLAG,FSAV
      COMMON/NAMES/SECNAM(3,11),GRPNAM(10,7),REGNAM(10,9),
     *CENNAM(9,4),INDEX(11),INDER(3)
      GO TO (10,20,30,40,50,60,70),N
10    CONTINUE
      WRITE(1,200) K
200   FORMAT('***TOO MANY REGIONS SPECIFIED.',I4,
     *' REGIONS REQUESTED',/,'WHEN THE MAXIMUM IS 10.***',
     */,'REENTER --')
      FLAG=-1
      RETURN
20    CONTINUE
```

```
      WRITE(1,201)(SECNAM(K,J),J=1,3)
201   FORMAT('***ILLEGAL VARIABLE NAME -- ',3A4,'***',/,
     *'REENTER -- ')
      FLAG=-1
      RETURN
30    CONTINUE
      WRITE(1,202)(SECNAM(K,J),J=1,3)
202   FORMAT('***ILLEGAL COMBINATION OF VARIABLES. ',3A4,/,
     *'MUST BE PROCESSED BY ITSELF BECAUSE SECTOR DEFINITIONS',/,
     *'DO NOT CORRESPOND TO OTHER VARIABLES SPECIFIED.***')
      FLAG=-1
      RETURN
40    CONTINUE
      WRITE(1,203) K
203   FORMAT('***TOO MANY INDUSTRIES SPECIFIED. ',I4,
     *' INDUSTRIES REQUESTED',/,'WHEN MAXIMUM IS 10.***')
      FLAG=-1
      RETURN
50    CONTINUE
      WRITE(1,204) K
204   FORMAT('***TOO MANY YEARS SPECIFIED.',I4,
     *' YEARS REQUESTED',/,'WHEN MAXIMUM IS 10.***')
      FLAG=-1
      RETURN
60    CONTINUE
      WRITE(1,205) K,NUMYR
205   FORMAT('***NUMBER OF FORECAST YEARS INPUT ',
     *'DOES NOT MATCH NUMBER OF FORECAST YEARS ',/,
     *'SPECIFIED. ONLY',I3,' YEARS HAVE BEEN INPUT ',
     *'WHEN',I3,' WERE SPECIFIED.***')
      FLAG=-1
      RETURN
70    CONTINUE
      WRITE(1,206)(REGNAM(K,J),J=1,9)
206   FORMAT('***WARNING: BUFFER NOT FILLED FOR ',
     *9A4,/,'PRINTED RESULTS FOR THIS REGION ARE ',
     *'INCORRECT.***')
      RETURN
      END
      SUBROUTINE OPENF
      INTEGER*2 ENDER,FLAG,FYEAR,CENT20,CENT21,CENT,FSAV
      DIMENSION FTIT(4),QTIT(16)
      COMMON/PARAM/KODE,NUMREG,NECIND,IGROUP,BLANK,ISTOP,
     *ENDER,SCALE,IFGRO,MULTI,ISCEN,FLAG,FSAV
      COMMON/YEARS/NUMYR,IYEAR(10),YEAR(10),FYEAR(10),
     *LYEAR(10),NYEARS
      DATA FTIT/'HARR','IS>A','LA>A','LA  '/
      DATA CENT20/1900/,CENT21/2000/,APPEND/'1   '/
      CALL DEFILE(6,'URBSYS>PERRIE>GENTST_FILNAM,',0,0,0)
      DO 5 I=1,16
      QTIT(I)=BLANK
5     CONTINUE
      IF(ISCEN.LT.0) QTIT(1)=APPEND
      DO 10 I=1,NUMYR
      CENT=CENT20
      IF(IYEAR(I).GT.1999) CENT=CENT21
      LYR=IYEAR(I)-CENT
      IF(LYR.EQ.0) GO TO 11
      WRITE(6,200)(FTIT(J),J=1,4),LYR,(QTIT(J),J=1,16)
200   FORMAT(3A4,A2,I2,16A4)
      GO TO 10
11    CONTINUE
      WRITE(6,201)(FTIT(J),J=1,4),LYR,LYR,(QTIT(J),J=1,16)
201   FORMAT(3A4,A2,2I1,16A4)
10    CONTINUE
      CALL EDFF
```

```
      RETURN
      END
      SUBROUTINE FDEF
      INTEGER*2 ISTAT,FYEAR
      DIMENSION FNAM(20)
      COMMON/YEARS/NUMYR,IYEAR(10),YEAR(10),FYEAR(10),
     *LYEAR(10),NYEARS
      ISTAT=80
      REWIND 6
      DO 5 I=1,NUMYR
      NU=10+I
      READ(6,100) FNAM
100   FORMAT(20A4)
      CALL ATRAN(NU,41,FNAM,0,ISTAT)
5     CONTINUE
      RETURN
      END
      SUBROUTINE CLNOUT(INDREG)
      INTEGER*2 CENMAP,RTRACK,ENDER,FLAG,REGREG,FSAV
      COMMON/MAPS/CENMAP(10,3),RTRACK(10)
      COMMON/PARAM/KODE,NUMREG,NECIND,IGROUP,BLANK,ISTOP,
     *ENDER,SCALE,IFGRO,MULTI,ISCEN,FLAG,FSAV
      COMMON/AREAS/ICODE(10,10),REGREG(10),KNTREG(10)
      DO 10 I=1,10
      IF(RTRACK(I).EQ.0) GO TO 10
      MAPREG=RTRACK(I)
      INT=I
      IF(KNTREG(MAPREG).EQ.0) CALL REPORT(MAPREG,INT,INDREG)
10    CONTINUE
      RETURN
      END
      SUBROUTINE AGGREG(INDREG,IREG,I8,I104,VAR,IY)
      INTEGER*2 ENDER,FLAG,REGREG,RTRACK,CENMAP,FSAV
      COMMON/PARAM/KODE,NUMREG,NECIND,IGROUP,BLANK,ISTOP,
     *ENDER,SCALE,IFGRO,MULTI,ISCEN,FLAG,FSAV
      COMMON/AREAS/ICODE(10,10),REGREG(10),KNTREG(10)
      COMMON/MAPS/CENMAP(10,3),RTRACK(10)
      COMMON/REGOUT/RVAR(10,30,10)
      K=I104+(I8-1)*IGROUP
      DO 11 I=1,10
      IF(IREG.EQ.RTRACK(I)) GO TO 13
11    CONTINUE
      DO 12 I=1,10
      IF(RTRACK(I).EQ.0) GO TO 14
12    CONTINUE
      STOP 5
13    CONTINUE
      RVAR(I,K,IY)=RVAR(I,K,IY)+VAR
      N=K*IY
      IF(N.LT.MULTI) RETURN
      CALL CLNOUT(INDREG)
      RETURN
14    CONTINUE
      RVAR(I,K,IY)=RVAR(I,K,IY)+VAR
      RTRACK(I)=IREG
      RETURN
      END
      SUBROUTINE AGGSEC(INDREG,IREG,IY)
      INTEGER*2 ENDER,FLAG,FSAV
      REAL*4 NAME
      COMMON/INDAT/IYR,IDC(5),NAME(9),AREA,FAC,USC(1445)
      COMMON/PARAM/KODE,NUMREG,NECIND,IGROUP,BLANK,ISTOP,
     *ENDER,SCALE,IFGRO,MULTI,ISCEN,FLAG,FSAV
      COMMON/INDUS/LGROUP(10,60),NLGRP(10),IND104(3)
      DO 10 I=1,NECIND
```

```
      DO 11 J=1,IGROUP
      VAR=0.
      N=NLGRP(J)
      DO 12 L=1,N
      M=LGROUP(J,L)
      VAR=VAR+USC(K+M)/SCALE
12    CONTINUE
      CALL AGGREG(INDREG,IREG,I,J,VAR,IY)
11    CONTINUE
10    CONTINUE
      RETURN
      END
      SUBROUTINE REPGRO(MREG,K,GRATES)
      INTEGER*2 FYEAR
      COMMON/NAMES/SECNAM(3,11),GRPNAM(10,7),REGNAM(10,9),
     *CENNAM(9,4),INDEX(11),INDER(3)
      COMMON/YEARS/NUMYR,IYEAR(10),YEAR(10),FYEAR(10),LYEAR(10),
     *NYEARS
      DIMENSION GRATES(10)
      WRITE(1,200)(GRPNAM(K,J),J=1,7),(GRATES(J),J=1,NUMYR)
200   FORMAT(1X,7A4,10F10.2)
      RETURN
      END
      SUBROUTINE HEDGRO(MREG,INDREG)
      INTEGER*2 REGREG,FYEAR
      COMMON/AREAS/ICODE(10,10),REGREG(10),KNTREG(10)
      COMMON/YEARS/NUMYR,IYEAR(10),YEAR(10),FYEAR(10),
     *LYEAR(10),NYEARS
      COMMON/NAMES/SECNAM(3,11),GRPNAM(10,7),REGNAM(10,9),
     *CENNAM(9,4),INDEX(11),INDER(3)
      COMMON/FORMS/FORM(63),FORGRO(63),RTYPE(2),DATER(4)
      DATA HYPH/'-'/
      K=IABS(REGREG(MREG))
      IF(INDREG.GT.1.AND.MREG.EQ.4) K=1
      WRITE(1,FORGRO) DATER
      WRITE(1,200) RTYPE
200   FORMAT(5X,'SCENARIO: ',2A4)
      WRITE(1,201)(REGNAM(MREG,J),J=1,9),(ICODE(MREG,J),J=1,K)
201   FORMAT(5X,'REGION NAME: ',9A4,/,5X,
     *'REGION NUMBER: ',10I5)
      WRITE(1,202)(FYEAR(I),HYPH,LYEAR(I),I=1,NUMYR)
202   FORMAT(/,7X,'VARIABLE NAME',9X,10(5X,I2,A1,I2))
      RETURN
      END
      SUBROUTINE RATER(MREG,INT)
      INTEGER*2 FYEAR,ENDER,FLAG,FSAV
      COMMON/YEARS/NUMYR,IYEAR(10),YEAR(10),FYEAR(10),LYEAR(10),
     *NYEARS
      COMMON/REGOUT/RVAR(10,30,10)
      COMMON/PARAM/KODE,NUMREG,NECIND,IGROUP,BLANK,ISTOP,
     *ENDER,SCALE,IFGRO,MULTI,ISCEN,FLAG,FSAV
      COMMON/NAMES/SECNAM(3,11),GRPNAM(10,7),REGNAM(10,9),
     *CENNAM(9,4),INDEX(11),INDER(3)
      DIMENSION GRO(10)
      N=0
      DO 10 I=1,NECIND
      L=INDER(I)
      WRITE(1,200)(SECNAM(I,J),J=1,L)
200   FORMAT(/,4X,3A4)
      DO 11 J=1,IGROUP
      N=N+1
      DO 12 K=1,NYEARS
      GRO(K)=0.
      IF(RVAR(INT,N,K).NE.0.)
     *GRO(K)=100.*(((RVAR(INT,N,K+1)/RVAR(INT,N,K))
     ***YEAR(K))-1.)
```

```
12    CONTINUE
      GRO(NUMYR)=0.
      IF(RVAR(INT,N,1).NE.0.)
     *GRO(NUMYR)=100.*(((RVAR(INT,N,NUMYR)/RVAR(INT,N,1))
     ***YEAR(NUMYR))-1.)
      CALL REPGRO(MREG,J,GRO)
11    CONTINUE
10    CONTINUE
      RETURN
      END
      SUBROUTINE HEADER(MREG,INDREG)
      INTEGER*2 REGREG,FYEAR
      COMMON/AREAS/ICODE(10,10),REGREG(10),KNTREG(10)
      COMMON/YEARS/NUMYR,IYEAR(10),YEAR(10),FYEAR(10),
     *LYEAR(10),NYEARS
      COMMON/NAMES/SECNAM(3,11),GRPNAM(10,7),REGNAM(10,9),
     *CENNAM(9,4),INDEX(11),INDER(3)
      COMMON/FORMS/FORM(63),FORGRO(63),RTYPE(2),DATER(4)
      K=IABS(REGREG(MREG))
      IF(INDREG.GT.1.AND.MREG.EQ.4) K=1
      WRITE(1,FORM) DATER
      WRITE(1,200) RTYPE
200   FORMAT(5X,'SCENARIO: ',2A4)
      WRITE(1,201)(REGNAM(MREG,J),J=1,9),(ICODE(MREG,J),J=1,K)
201   FORMAT(5X,'REGION NAME: ',9A4,/,5X,
     *'REGION NUMBER: ',10I5)
      WRITE(1,202)(IYEAR(I),I=1,NUMYR)
202   FORMAT(/,7X,'VARIABLE NAME',8X,10(6X,I4))
      RETURN
      END
      SUBROUTINE REGCHK(INDREG,IREG)
      INTEGER*2 ENDER,FLAG,FSAV,REGREG
      REAL*4 NAME
      COMMON/PARAM/KODE,NUMREG,NECIND,IGROUP,BLANK,ISTOP,
     *ENDER,SCALE,IFGRO,MULTI,ISCEN,FLAG,FSAV
      COMMON/AREAS/ICODE(10,10),REGREG(10),KNTREG(10)
      COMMON/INDAT/IYR,IDC(5),NAME(9),AREA,FAC,USC(1445)
      COMMON/NAMES/SECNAM(3,11),GRPNAM(10,7),REGNAM(10,9),
     *CENNAM(9,4),INDEX(11),INDER(3)
      GO TO (10,30),INDREG
10    CONTINUE
      DO 11 I=1,NUMREG
      K=IABS(REGREG(I))
      DO 12 J=1,K
      IF(IDC(1).EQ.ICODE(I,J)) GO TO 13
12    CONTINUE
11    CONTINUE
      KODE=-1
      RETURN
13    CONTINUE
      KNTREG(I)=KNTREG(I)-1
      IREG=I
      KODE=1
      IF(REGREG(I).LT.0) GO TO 14
      DO 15 J=1,9
      REGNAM(I,J)=BLANK
      REGNAM(I,J)=NAME(J)
15    CONTINUE
14    RETURN
30    CONTINUE
      NREG=NUMREG-1
      DO 31 I=1,NREG
      K=IABS(REGREG(I))
      DO 32 J=1,K
      IF(IDC(1).EQ.ICODE(I,J)) GO TO 33
```

```
31    CONTINUE
      I=4
33    CONTINUE
      KNTREG(I)=KNTREG(I)-1
      IREG=I
      KODE=1
      RETURN
      END
      SUBROUTINE REPORT(MREG,INT,INDREG)
      INTEGER*2 FYEAR,ENDER,FLAG,CENMAP,RTRACK,FSAV
      COMMON/NAMES/SECNAM(3,11),GRPNAM(10,7),REGNAM(10,9),
     *CENNAM(9,4),INDEX(11),INDER(3)
      COMMON/YEARS/NUMYR,IYEAR(10),YEAR(10),FYEAR(10),LYEAR(10),
     *NYEARS
      COMMON/REGOUT/RVAR(10,30,10)
      COMMON/PARAM/KODE,NUMREG,NECIND,IGROUP,BLANK,ISTOP,
     *ENDER,SCALE,IFGRO,MULTI,ISCEN,FLAG,FSAV
      COMMON/MAPS/CENMAP(10,3),RTRACK(10)
      ENDER=ENDER+1
      IF(FSAV.LT.0)WRITE(7)(REGNAM(MREG,J),J=1,9)
      CALL HEADER(MREG,INDREG)
      N=0
      DO 11 I=1,NECIND
      WRITE(1,200)(SECNAM(I,J),J=1,11)
200   FORMAT(/,4X,11A4)
      DO 12 J=1,IGROUP
      N=N+1
      WRITE(1,201)(GRPNAM(J,K),K=1,7),(RVAR(INT,N,K),K=1,NUMYR)
201   FORMAT(1X,7A4,10F10.0)
      IF(FSAV.LT.0) WRITE(7)(RVAR(INT,N,K),K=1,NUMYR)
12    CONTINUE
11    CONTINUE
      IF(IFGRO.GT.0) GO TO 13
      CALL HEDGRO(MREG,INDREG)
      CALL RATER(MREG,INT)
13    CONTINUE
      RTRACK(INT)=0
      DO 20 K=1,NUMYR
      N=0
      DO 20 J=1,IGROUP
      DO 20 I=1,NECIND
      N=N+1
      RVAR(INT,N,K)=0.
20    CONTINUE
      RETURN
      END
      SUBROUTINE EXPAND(IS,K)
      COMMON/INDUS/LGROUP(10,60),NLGRP(10),IND104(3)
      DIMENSION LTEMP(60)
      DO 1 J=1,60
      LTEMP(J)=LGROUP(IS,J)
1     CONTINUE
      K=0
      DO 2 J=1,60
      K=K+1
      IF(LTEMP(J).EQ.0) RETURN
      LGROUP(IS,K)=LTEMP(J)
      IF(LTEMP(J).GT.0) GO TO 2
      K=K-1
      IEND=IABS(LTEMP(J))
      IBEG=LTEMP(J-1)+1
      DO 3 L=IBEG,IEND
      K=K+1
      LGROUP(IS,K)=L
3     CONTINUE
2     CONTINUE
```

```
      RETURN
      END
OK,
```

```
      PARAMETER NYEAR=7
      COMMON/NAMES/RNAM(4,8),SECNAM(38,8)
      COMMON/REGDAT/REG(39,7),GRO(38,3)
      DIMENSION IYEAR(7),REGIN(2,38,7)
      DATA IYEAR/1983,1984,1985,1986,1987,1988,1989/
      CALL DEFILE(11,'URBSYS>KEY_SERIES_BASE_MAR10.CPER,',0,10,0)
      CALL DEFILE(12,'URBSYS>KEY_SERIES_IMPACT_MAR10.CPER,',0,10,0)
      CALL DEFILE(8,'URBSYS>PERRIE>NAMER,',0,10,0)
      CALL DEFILE(18,'URBSYS>COMPARE.IMPACT-BASE.M10.CPER,',0,0,0)
      READ(8,100)((RNAM(I,J),J=1,8),I=1,4)
100   FORMAT(8A4)
      READ(8,100)((SECNAM(I,J),J=1,8),I=1,38)
      DO 10 NR=1,4
      DO 11 K=1,2
      NU=10+K
      DO 12 I=1,38
      READ(NU,101)(REGIN(K,I,J),J=1,7),(GRO(I,J),J=1,3)
101   FORMAT(5E13.7)
12    CONTINUE
11    CONTINUE
      DO 15 J=1,7
      DO 16 I=1,38
      REG(I,J)=REGIN(2,I,J)-REGIN(1,I,J)
16    CONTINUE
      REG(39,J)=FLOAT(IYEAR(J))
15    CONTINUE
      CALL REPORT(NYEAR,NR)
10    CONTINUE
      CALL DEFILE(0,0,0,0,0)
      STOP
      END
      SUBROUTINE REPORT(NYEAR,NR)
      REAL*8 THOUS,AMILL,ACTUAL,DOLLAR,DEMOG
      COMMON/REGDAT/ST(39,7),GRO(38,3)
      COMMON/NAMES/RNAM(4,8),SECNAM(38,3)
      DIMENSION LYEAR(7)
      DATA THOUS/'THOUSAND'/,AMILL/' MILLION'/,
     *ACTUAL/'  ACTUAL'/
      DOLLAR=THOUS
      DEMOG=ACTUAL
      IF(NR.NE.3) GO TO 2
      DO 1 J=1,7
      DO 1 I=1,38
      ST(I,J)=ST(I,J)*1000.
1     CONTINUE
2     CONTINUE
      WRITE(18,200)
200   FORMAT(///,32X,'REGIONAL SUMMARIES OF KEY ECONOMIC INDICATORS',
     *6X,'IMPACT-BASELINE',/,32X,45('-'))
      WRITE(18,201)(RNAM(NR,J),J=1,8)
201   FORMAT(39X,8A4)
      DO 10 I=1,NYEAR
      LYEAR(I)=IFIX(ST(39,I))
10    CONTINUE
      WRITE(18,202)(LYEAR(I),I=1,NYEAR)
202   FORMAT(9X,'VARIABLE NAME',10X,7(6X,I4),
     */,9X,13('-'),10X,7(6X,4('-')))
      WRITE(18,203) DOLLAR
203   FORMAT(' OUTPUT (',A8,'S OF 76$)')
      DO 15 I=1,9
      WRITE(18,204)(SECNAM(I,J),J=1,8),(ST(I,J),J=1,7)
204   FORMAT(1X,8A4,7F10.0)
```

```
 15   CONTINUE
      WRITE(18,209) DEMOG
 209  FORMAT(/,' EMPLOYMENT (',A8,'S)')
      DO 16 I=10,18
      WRITE(18,204)(SECNAM(I,J),J=1,8),(ST(I,J),J=1,7)
 16   CONTINUE
      WRITE(18,205) DEMOG
 205  FORMAT(/,' DEMOGRAPHICS (',A8,'S)')
      DO 17 I=19,28
      WRITE(18,204)(SECNAM(I,J),J=1,8),(ST(I,J),J=1,7)
 17   CONTINUE
      WRITE(18,206) DOLLAR
 206  FORMAT(/,' INCOME (',A8,'S OF 76$)')
      DO 18 I=29,35
      WRITE(18,204)(SECNAM(I,J),J=1,8),(ST(I,J),J=1,7)
 18   CONTINUE
      WRITE(18,207) DOLLAR
 207  FORMAT(/,' GOVERNMENT EXPENDITURES',/,
     *3X,'(',A8 'S OF 76$)')
      DO 19 I=36,38
      WRITE(18,204)(SECNAM(I,J),J=1,8),(ST(I,J),J=1,7)
 19   CONTINUE
      WRITE(18,199)
 199  FORMAT(//)
      RETURN
      END
OK,
```

```
      REAL*8 XDAT
      COMMON/PARAM/NUMREG(2),NECIND(2),IGROUP(2)
      COMMON/YEARS/NUMYR(2),IYEAR(10,2)
      COMMON/FORMS/FORM(63),DATER(4)
      COMMON/NAMES/SECNAM(3,11),GRPNAM(10,7),REGNAM(9)
      COMMON/REGOUT/VAR(30,10)
      DIMENSION FBASE(20),FIMP(20),HEAD0(2),HEAD1(12),
     *HEAD2(7,2)
      DIMENSION RVAR(2,30,10)
      DATA BLANK/'    '/
      DATA HEAD0/'(///',','' '/
      DATA HEAD1/'   C','OOSA',' RIV','ER N','AVIG','ATIO',
     *'N PR','OJEC','T''','5','X,4A','4,/,',''' '/
      DATA HEAD2/'KEY ','ECON','OMIC',' IND','ICAT','ORS''',
     *',/,''',' -','----','----','----','----','----',
     *'--'')'/
      CALL ATTDEV(1,1,1,66)
      XDAT=DATE$A(DATER)
      CALL DATE$A(DATER)
      WRITE(1,100)
  100 FORMAT(' INPUT BASELINE FORECAST FILENAME')
      READ(1,200) FBASE
  200 FORMAT(20A4)
      WRITE(1,101)
  101 FORMAT(' INPUT IMPACT FORECAST FILENAME')
      READ(1,200) FIMP
      CALL DEFILE(11,FBASE,80,10,0)
      CALL DEFILE(12,FIMP,80,10,0)
      DO 10 I=1,2
      NU=10+I
      READ(NU) NUMYR(I),NUMREG(I),NECIND(I),IGROUP(I)
      K=NUMYR(I)
      READ(NU)(IYEAR(J,I),J=1,K)
      L=NECIND(I)
      DO 9 J=1,L
      READ(NU)(SECNAM(J,M),M=1,11)
    9 CONTINUE
      L=IGROUP(I)
      DO 8 J=1,L
      READ(NU)(GRPNAM(J,M),M=1,7)
    8 CONTINUE
   10 CONTINUE
      IF(NUMYR(1).NE.NUMYR(2)) CALL ERRCDE
      IF(NUMREG(1).NE.NUMREG(2)) CALL ERRCDE
      IF(NECIND(1).NE.NECIND(2)) CALL ERRCDE
      IF(IGROUP(1).NE.IGROUP(2)) CALL ERRCDE
      DO 11 J=1,K
      IF(IYEAR(J,1).NE.IYEAR(J,2)) CALL ERRCDE
   11 CONTINUE
      MULTI=IGROUP(1)*NECIND(1)
      DO 40 I=1,63
      FORM(I)=BLANK
   40 CONTINUE
      K=0
      DO 41 I=1,2
      K=K+1
      FORM(K)=HEAD0(I)
   41 CONTINUE
      L=NUMYR(1)
      DO 42 I=1,L
      K=K+1
      FORM(K)=BLANK
```

```
 42   CONTINUE
      DO 43 I=1,12
      K=K+1
      FORM(K)=HEAD1(I)
 43   CONTINUE
      L=L+2
      DO 44 J=1,2
      DO 45 I=1,L
      K=K+1
      FORM(K)=BLANK
 45   CONTINUE
      DO 46 I=1,7
      K=K+1
      FORM(K)=HEAD2(I,J)
 46   CONTINUE
 44   CONTINUE
      NYR=NUMYR(1)
      NREG=NUMREG(1)
      DO 50 IR=1,NREG
      DO 51 I=1,2
      NU=10+I
      READ(NU)(REGNAM(J),J=1,9)
      DO 52 J=1,MULTI
      READ(NU)(RVAR(I,J,K),K=1,NYR)
 52   CONTINUE
 51   CONTINUE
      DO 53 K=1,NYR
      DO 54 J=1,MULTI
      VAR(J,K)=RVAR(2,J,K)-RVAR(1,J,K)
 54   CONTINUE
 53   CONTINUE
      CALL REPORT(MULTI)
 50   CONTINUE
      CALL DEFILE(0,0,0,0,0)
      STOP
      END
      SUBROUTINE ERRCDE
      WRITE(1,100)
 100  FORMAT(' MISMATCHED FILES - EXECUTION TERMINATING')
      CALL DEFILE(0,0,0,0,0)
      STOP
      END
      SUBROUTINE HEADER
      COMMON/NAMES/SECNAM(3,11),GRPNAM(10,7),REGNAM(9)
      COMMON/YEARS/NUMYR,NDUM1,IYEAR(10),IDUM(10)
      COMMON/PARAM/NUMREG,NDUM2,NECIND,NDUM3,IGROUP,NDUM4
      COMMON/FORMS/FORM(63),DATER(4)
      WRITE(1,FORM) DATER
      WRITE(1,201)(REGNAM(J),J=1,9)
 201  FORMAT(5X,'REGION NAME: ',9A4)
      WRITE(1,202)(IYEAR(I),I=1,NUMYR)
 202  FORMAT(/,7X,'VARIABLE NAME',3X,10(6X,I4))
      RETURN
      END
      SUBROUTINE REPORT(MULTI)
      COMMON/NAMES/SECNAM(3,11),GRPNAM(10,7),REGNAM(9)
      COMMON/YEARS/NUMYR,NDUM1,IYEAR(10),IDUM(10)
      COMMON/REGOUT/VAR(30,10)
      COMMON/PARAM/NUMREG,NDUM2,NECIND,NDUM3,IGROUP,NDUM4
      CALL HEADER
      L=0
      DO 11 I=1,MULTI
      IF(MOD(I,IGROUP).NE.1) GO TO 12
      KSEC=0
      L=L+1
      WRITE(1,200)(SECNAM(L,J),J=1,11)
```

```
200  FORMAT(/,4X,11A4)
12   CONTINUE
     KSEC=KSEC+1
     WRITE(1,201)(GRPNAM(KSEC,J),J=1,7),(VAR(I,J),J=1,NUMYR)
201  FORMAT(1X,7A4,10F10.0)
11   CONTINUE
     RETURN
     END
OK,
```

APPENDIX I

DATA DEVELOPMENT FOR THE

COOSA RIVER NAVIGATION PROJECT

APPENDIX I

DATA DEVELOPMENT FOR THE COOSA RIVER NAVIGATION PROJECT

I.1 Introduction

The Coosa River Navigation Project is part of a larger Alabama-Coosa River Navigation Project, originally authorized in 1945, that has been envisioned to run 596 miles from Rome, Georgia to Mobile, Alabama. The first phase of the overall project, from the junction of the Tombigbee and Alabama Rivers to Montgomery, was completed in 1972. Completion of the final phase from Gadsden, Alabama to Rome is contingent upon completion of the current project (Phase II) at which time its merits will be re-studied.

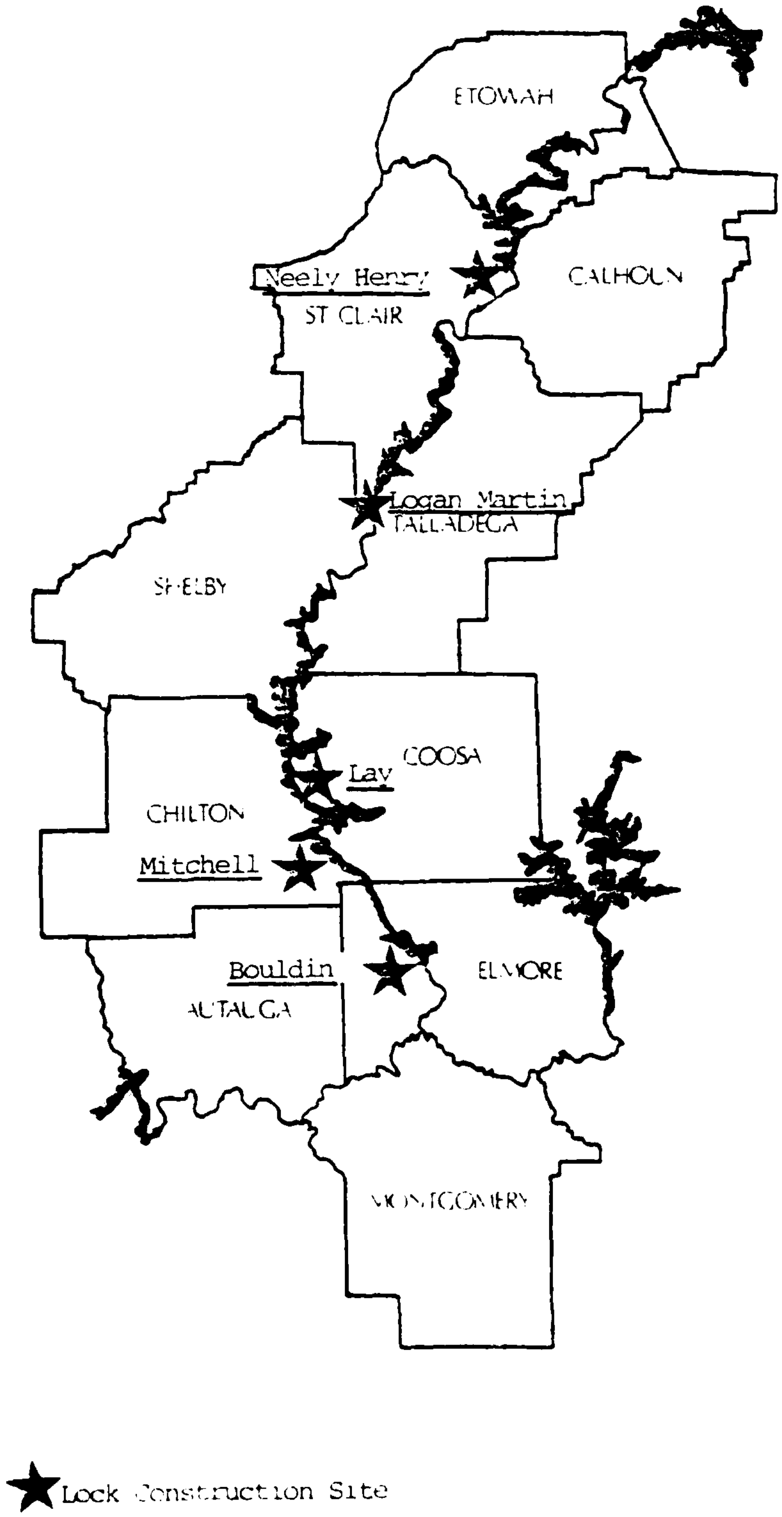
Phase II of the Alabama Coosa River Navigation Project calls for the construction and operation of a 163-mile navigable waterway between Montgomery and Gadsden. Completion of the project will require:

- o dredging of a 9 foot by 150 foot channel in the Coosa River from Montgomey to Gadsden;
- o reconstruction of five dams operated by Alabama Power Company along that stretch of the river to install lockages (Figure I-1);
- o relocation of various railroad and highway bridges, electric power lines and roads along the channel; and
- o construction or purchase of various support facilities to operate the waterway.

Included in the project plan is the construction of a spur channel in Black Creek at Gadsden to the Republic Steel Corporation

FIGURE I-1

PHASE II LOCK CONSTRUCTION SITES



to connect this potential waterway user to the main channel. A total of eight highway and seven railroad bridges will require relocation or reconstruction over the 163 mile waterway. In addition, six powerlines, six communication lines and four pipelines will require relocation, as will four bridges connecting secondary roads and one local road near the Logan Martin Dam.

Dredging operations will be necessary in the upper reaches of the impoundments created by the five Alabama Power Company locks along the waterway to provide a channel of nine foot depth for navigation. Locks will be constructed to the same dimensions as locks on the completed stretch of the Alabama-Coosa River Navigation Project. Total capital costs for this phase of the project are estimated to be approximately $1.15 billion (1981 dollars), of which $1.1 billion will be federal costs and $.034 billion non-federal.

In addition to altering the Coosa River physically, the navigation project represents a significant injection of funds into the Coosa River Region during the design and construction phase. More importantly, in operation it represents a catalyst for changing the basic structure of local economics in the region. By introducing a new mode of transport which can carry certain commodities to and from external markets more cheaply, the waterway will alter the competitive advantage of the region for attracting growth relative to all other regions, encouraging development of a kind that would not have occurred otherwise.

The injection of federal, state and local funds into the region and the subsequent changes in transport costs are but the first-order effects of the project. Over time, these effects will work their way through local and regional economies inducing further growth and diversification. The nature and magnitude of this secondary growth depends upon the initial structure of the economy and the degree to which development is facilitated by local populations. In this study economic development associated with the project is estimated using an econometric modeling framework.

It is convenient to consider the direct effects of the navigation project by type of impact. In all, five categories of direct impact are anticipated:

- o construction impacts
- o transportation cost impacts
- o waterway operation and maintenance impacts
- o power generation and revenue impacts
- o rail and truck carrier revenue impacts.

The planning, design and construction phase of the project are expected to proceed in several stages over the 1980 to 1990 period. The first three years of the project are devoted solely to planning and design of the waterway with land acquisition and construction to be phased in after that (Table I-1). Construction, and thus its impacts, are expected to advance up the Coosa River from the south end of the navigation project as each of the five dams undergoes modification.

subsequently extended by estimating a simple first order difference equation using population aged 15-24 in the year t-10 as the independent variable.

$$POP_{25-34}(t) = 1.11 + 0.96\ POP_{15-24}(t-10)$$

Population aged 25 to 34 for 2039 was estimated from the value derived from this equation by interpolation.

Households

The number of households was estimated for all forecast years (1985-2039) using the regression equation:

$$HOUSEHOLDS\ (t) = -74.33 + 0.58\ POP\ (t) + 1.55\ \%\ POP_{25-34}\ (t)$$

Historical data for estimating coefficients were derived from Census sources for the period 1970 to 1979.[1]

Percentage of Households with Head Aged 25-34

The percentage of households with head aged 25 to 34 was also calculated for the entire forecast period (1985-2039), and was expressed simply as a function of the percentage of the population in the same age bracket.

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[1]U.S. Department of Commerce, Bureau of the Census, Statistical Abstract of the United States: 1980. Washington, DC: U.S. Government Printing Office, 1980.

Table I-1

SCHEDULE OF FUNDS FOR THE INITIAL DEVELOPMENT OF THE MONTGOMERY TO GADSEN, COOSA RIVER PROJECT

Fiscal Year			
Thru	1980	Planning and Design	$ 5,300,000
	1981	Planning and Design	6,900,000
	1982	Planning and Design	8,000,000
	1983	Planning, design, land acquisition and construction	11,000,000
	1984	Planning design, land acquisition and construction	112,000,000
	1985	Planning, design, land acquisition and construction	146,000,000
	1986	Planning, design, land acquisition and construction	197,000,000
	1987	Planning, design, land acquisition and construction	277,000,000
	1988	Planning, design, land acquisition and construction	205,000,000
	1989	Construction	118,000,000
	1990	Construction	62,800,000
		TOTAL	$1,149,000,000

With a project of this magnitude, the employment impacts are expected to be considerable. PLANTEC Corporation has estimated that direct and induced construction employment peaks could approach 1,100 workers at the Bouldin Bam area, 1,200 at the Mitchell and Lay Dam areas, 1,500 at the Logan Dam area and 1,400 workers at the Henry Dam area over the construction period.[1] As the construction of locks will be phased over time, the cumulative employment impacts will not be additive. However, they represent significant stimulations to the local economies along the river, as over $300 million in payrolls will be added to the region by the project.

In addition to expenditures on labor, substantial investment in equipment, materials and services will be required during the construction phase of the project. Corps estimates indicate that over $80 million (1981 dollars) will be spent on lock equipment between 1985 and 1990 for this purpose. Materials and services account for the remainder of the $1.1 billion federal investment.

Like construction expenditures that result in employment, expenditures on equipment, materials and services are likely to have highly stimulative effect on the Coosa River Region economy. Once the waterway is opened to navigation, costs of transporting materials and products into and out of the Coosa River Region will be impacted. Opening the Coosa River to navigation will introduce a new mode of transportation into the region which, for many

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[1]PLANTEC Corporation, Coosa River Navigation Project. Prepared for U.S. Corps of Engineers, October 1981.

commodities, is competitive to rail and truck transportation. The Corps traffic survey identified 35 commodities totalling over 4 million short tons currently imported into or exported from the Coosa River Region annually that could be shipped more inexpensively by barge than by rail or truck Assuming that shippers will switch to the least expensive mode, the direct transportation cost impacts of opening the waterway to navigation will be reduced shipping costs, thereby lowering the cost of doing business in the region. Reduced costs should, in turn, improve the competitive standing of the region relative to all others, making it more attractive for industries to produce, expand or locate there.

Note that the beneficiaries of transportation cost savings are not only those industries that are located in the Coosa River Region. In addition, industries in regions that engage in trade with the Coosa Region will also be impacted directly by the cost advantages associated with barge travel. Assuming that commodities are shipped F.O.B., transportation cost savings will accrue to the purchasers of commodities, ie., on commodities that are imported into the regions. Indirect and induced impacts associated with lower transportation costs brought about by the navigation project are therefore expected to be more spatially dispersed than construction impacts.

Direct impacts associated with the operation and maintenance of the waterway will result from personnel costs, costs of maintenance and supplies, spare parts costs, operation support costs, costs of procuring major replacement costs and a one-time cost of establishing a Montgomery Area office. These costs are expected to begin phasing into the Coosa River regional economy in 1987 with the completion of locks at the Henry Bouldin Dam and will increase annually as locks are successively completed upstream. Operation and maintenance costs are expected to remain constant through 2039 once all construction activity ceases in 1990.

In comparison to construction cost estimates, direct operation and maintenance impacts are relatively small although, because they apply annually, they have a more permanent effect on the region's economy. Direct employment impacts are expected to arise from expenditures on personnel to operate and maintain the locks (constituting over a third of the annual O&M budget) and from government contracting for private maintenance services. Government purchases of replacement equipment and spare parts are also expected to impact the Coosa River Region's economy, though only minimally because of their small magnitude.

The two remaining impact categories, power generation and revenue impacts, and rail and truck carrier revenue impacts, are expected to have a negative effect on the region's economy. Installation of locks in Alabama Power Company dams will reduce water flow available for power generation. These losses will have to be replaced by electrical power generated by other Alabama Power Company capacity or purchased from other distributors. This study has assumed that Alabama Power will purchase electricity at wholesale prices to compensate for power losses in their hydroelectric capacity. As wholesale prices for electricity are greater than costs of generating equivalent quantities of hydroelectricity on the Coosa River, the difference constitutes a revenue loss for the utility. These revenue losses, which occur annually after 1990, constitute a direct economic impact in the Coosa River Region. It is important to note, however, that importation of electrical power by Alabama Power Company into the region also constitutes a revenue gain to a utility or utilities outside the service area. Thus, while the Coosa River Region is expected to be negatively impacted by hydroelectric generation losses associated with the operation of the waterway, regions outside the Alabama Power Company service area are expected to be positively impacted.

The introduction of a new mode of transportation into the region constitutes new competition for carriers that had previously established themselves there. Because barge transportation is directly cost competitive with rail and truck transportation for certain commodities, rail and truck revenues are anticipated to decline in the region as shippers choose the least expensive mode. Direct impacts of the navigation project upon these carriers are therefore annual reductions in rail and truck revenues attributable to traffic lost to barge transportation once the waterway is operational.

I.2 National Economic Controls

The macroeconomic projection used in this study is based on one developed for the 1980 OBERS BEA Regional Projections.[1] The Bureau of Economic Analysis, in constructing this forecast, utilized the Bureau of Labor Statistics Long-Run Macroeconomic Model to project labor force and output data to the year 2000. These estimates were subsequently extended to 2030 by BEA analysts. Major assumptions utilized for this forecast are documented in the publication cited above. Population forecasts were developed by the Bureau of the Census.[2]

In order to provide sufficient data to develop a national economic forecast using INFORUM, additional economic data were developed to supplement those in the OBERS forecast. Also, the macroeconomic projection was extended a further nine years, to 2039, to satisfy Corps requirements. A total of 9 macroeconomic parameters were forecast independently from the INFORUM model for use as input data; all other variables were estimated endogenously.

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[1] U.S. Department of Commerce, 1980 OBERS BEA Regional Projections. Volume 1: Methodology, Concepts and State Data. Washington, DC: U.S. Government Printing Office, July, 1981.

[2] U.S. Department of Commerce, Bureau of the Census, Current Population Reports, Series P-25, No. 704, July 1977; U.S. Department of Commerce, Bureau of the Census, Current Population Reports, Series P-25, No. 729, August 1978.

These exogenous parameters are:

- population
- population aged 25-34
- households
- percentage of households with head aged 25-34
- government spending
- per capita disposable income
- total labor force
- military employment
- civilian employment by type

Derivation of these projections are discussed below.

Total Population

Total population estimates were forecast to 2030 in the OBERS report and thus only one additional estimate, for 2039, was required.[1] Total population for 2039 was calculated by assuming that population would grow at the same rate as the 2020 to 2030 period. This assumption resulted in an average annual growth rate of 0.34 percent. (Compare this with an average annual growth rate of 0.9 percent between 1970 and 1980.)

Population (25-34)

OBERS Population projections were also broken down by age cohort to 2030. The projection for population aged 25-34 was

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[1]Macroeconomic data were forecast at 10 year intervals and were subsequently interpolated to annual estimates by INFORUM.

$$\% \text{ HOUSEHOLDS w. HEAD}_{25-34}(t) = 5.64 + 1.05 \% \text{ POP}_{25-34}(t)$$

Coefficients were estimated over historical data from 1970 through 1979.

Government Spending

Government spending was estimated for both the federal and the state and local levels of government in a two-stage process. First, total government spending as a percentage of Gross National Product was projected over the forecast period. From a 1980 value of approximately 19.3 percent,[1] government spending was assumed to decline monotonically to 17.5 percent by the year 2000 and remain at this level for the remainder of the forecast period.

Estimating the dollar value of government expenditures from percentage of GNP estimates required a GNP forecast to 2039. Final GNP estimates were not specified exogenously for the INFORUM forecast but were generated internally as the sum of its components. A BEA forecast of GNP to 2030 was taken from the 1980 OBERS BEA Regional Projections report for this purpose. A GNP estimate for 2039 was extrapolated from 2030 using the 2000 to 2030 GNP growth rate assumed by BEA. Total government expenditures were then apportioned between the federal and state and local governments

[1] U.S. Department of Commerce, Bureau of the Census, Statistical Abstract of the United States: 1980. Washington, DC: U.S. Government Printing Office, 1980.

by assuming the federal percentage to remain constant at 36.7 percent over the forecast period. This value is consistent with historical data over the 1976 to 1980 period.

Per Capita Disposable Income

While BEA forecast per capita personal income in its OBERS projections, no estimates of disposable personal income were made. Per capita disposable income was estimated for this study by assuming it to be a constant proportion (85 percent) of per capita personal income over the forecast period. (Per capita disposable income has varied between 84 and 87 percent of per capita personal income since 1960.) A value for 2039 was derived by extrapolating personal income from 2030 using the 2020 to 2030 growth rate assumed by BEA.

Total Labor Force

Total labor force projections to 2030 were developed by BEA for its OBERS forecast. These were extended to 2039 using to 2020 to 2030 growth rate assumed by BEA.

Military Employment

BEA assumed that military employment would rise to 2.089 million by 1985 and remain constant through the remainder of the forecast. This assumption was maintained in the extension of the projection to 2039.

Civilian Employment

Civilian employment estimates were required for farm, non-farm, government and total employment categories. Estimates to 2030 were taken from BEA OBERS projections. Total employment, farm employment and government employment categories were subsequently extrapolated to 2039 using 2020-2030 trends. Non-farm employment for 2039 was then calculated as the difference between total employment and farm employment in that year.

These macroeconomic projections formed the basis for the INFORUM forecast used to control MRMI regional estimates over the 1980 to 2039 period. The projections are given in Table I-2. The remaining macroeconomic data forecast by INFORUM are shown in Table I-3.

I.3 Construction Impacts

The total cost of the Coosa River project ($1.15 billion) is estimated in The General Design Memorandum (GDM) issued by the Corps of Engineers in October 1981. The costs given in the GDM are based on October 1981 prices for materials and labor.

As input data for the MRMI model, construction impacts are allocated to one of two sectors:

(1) Public Construction Sector 24: Water Systems. This sector accounts for all construction expenditures except equipment purchases;

2) Equipment Purchasing Sector 66: Buses, Waterways, and Pipelines.

Table I-2

MACROECONOMIC PROJECTIONS INPUT TO INFORUM

Year	Population (millions)	Households (millions)	Population 25-24 (millions)	% Households with Head 25-34	Government Spending Total (billions of 1972$)	Federal	State & Local
1985	232.35	86.04	39.68	23.58	334.4	122.7	211.7
1990	242.90	91.79	40.91	23.32	382.2	140.3	242.0
1995	252.22	94.37	37.90	21.45	425.5	156.2	269.3
2000	259.05	95.08	34.27	19.49	475.8	174.6	301.2
2010	274.00	104.40	36.07	19.43	610.7	224.1	386.6
2020	289.50	113.63	39.34	19.90	750.5	275.4	475.1
2030	299.82	117.71	37.19	18.66	931.3	341.8	589.5
[illegible]	309.34	124.04	40.06	19.24	950.8	348.9	601.8

Year	Per Capita Disposable Personal Income (1972$)	Total Labor Force (millions)	Military Employment (millions)	Civilian Employment (millions) Total	Farm	Non-Farm	Government
1985	5,450	115.04	2.089	106.97	3.24	103.72	16.74
1990	6,200	121.46	2.089	113.52	2.92	110.59	17.30
1995	6,857	125.17	2.089	117.29	2.81	114.48	18.31
2000	7,645	129.75	2.089	121.92	2.70	119.22	19.00
2010	9,375	136.62	2.089	128.74	2.47	126.27	20.19
2020	11,005	136.85	2.089	129.24	2.25	126.99	20.55
2030	13,389	138.07	2.089	130.54	2.14	128.40	20.91
2039	15,870	139.12	2.089	131.72	2.04	129.68	21.23

Table I-3

SEIST TABP

TO 2030 FOR URBSYL: DEC 1 AT 11PM — GNP SUMMARY (BILLIONS OF 1972$)

	1977	1985	1990	1995	2000	2005	2010	2020	2030	2039
GROSS NATIONAL PRODUCT	1340.08	1859.69	2148.91	2427.63	2747.76	3142.17	3540.15	4361.35	5420.62	6413.64
PERSONAL CONSUMPTION EXPENDITURES	861.70	1176.50	1396.66	1602.87	1841.08	2108.17	2387.15	2973.70	3717.70	4545.09
DURABLE GOODS	138.20	198.00	227.94	260.83	302.47	348.25	395.35	492.73	615.46	740.84
NONDURABLE GOODS	332.70	439.47	512.46	576.08	645.81	724.79	808.00	981.87	1209.54	1473.07
SERVICES	390.80	539.03	656.27	765.95	892.81	1035.14	1183.80	1499.19	1892.69	2325.17
GROSS PRIVATE DOMESTIC INVESTMENT	200.00	321.01	327.21	349.92	387.08	445.18	493.80	597.82	740.72	875.35
STRUCTURES	95.50	146.90	147.01	152.10	163.75	182.18	197.65	232.43	284.85	343.08
RESIDENTIAL	56.40	85.37	79.61	78.32	81.94	89.16	93.96	105.41	126.47	152.64
NON-RESIDENTIAL	39.10	61.53	67.40	73.78	81.81	93.02	103.69	127.02	158.38	190.44
PRODUCERS' DURABLE EQUIPMENT	91.40	140.21	154.44	173.16	196.87	229.64	260.44	325.12	405.94	470.64
AGRICULTURE	7.00	9.88	10.39	11.30	12.30	13.61	14.81	17.28	20.66	23.89
MINING	5.50	7.17	9.33	11.49	14.38	17.54	21.06	29.02	39.22	49.74
CONSTRUCTION	4.40	6.71	7.38	8.15	9.04	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NONDURABLE GOODS	13.50	20.52	22.71	25.12	28.44	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
DURABLE GOODS	13.80	23.64	23.68	25.93	28.91	33.32	36.24	44.15	54.32	61.92
TRANSPORTATION	3.90	7.34	7.80	8.44	9.29	10.49	11.52	13.60	16.47	18.81
COMMUNICATION	7.80	13.24	14.52	16.06	18.73	21.01	24.60	30.56	38.38	45.24
UTILITIES	7.90	10.78	11.97	13.84	16.08	18.65	21.16	26.60	33.79	41.08
TRADE	9.90	15.96	17.10	18.83	21.36	24.48	27.41	33.48	41.63	49.14
FINANCE AND SERVICES	16.50	23.06	27.38	31.70	36.03	42.95	49.88	63.74	77.59	90.07
RESIDENTIAL PDE	1.20	1.96	2.34	2.22	3.09	3.69	4.28	5.47	6.66	7.74
INVENTORY CHANGE	13.10	33.91	25.76	24.67	27.26	31.36	35.71	40.27	50.00	53.62
EXPORTS OF GOODS AND SERVICES	80.07	129.51	166.53	185.72	201.89	224.92	248.00	294.35	354.44	413.05
MERCHANDISE	59.08	97.97	126.98	140.95	151.95	168.44	184.94	217.93	260.91	302.90
MARGINS AND SCRAP	8.65	13.80	17.77	19.69	21.19	23.45	25.71	30.23	36.11	41.86
TRAVEL	3.38	4.93	5.77	6.52	7.42	8.41	9.40	11.35	13.90	16.81
PASSENGER FARES, OTH TRANSPORT	4.33	5.20	6.31	7.26	8.24	9.40	10.55	12.87	15.69	18.35
OTHER PRIVATE SERVICES	4.63	7.62	9.71	11.30	13.09	15.22	17.41	21.97	27.77	33.23
IMPORTS OF GOODS AND SERVICES	-70.19	-101.54	-120.59	-138.27	-156.78	-180.58	-204.02	-251.64	-312.82	-368.60
MERCHANDISE	-60.85	-87.60	-103.43	-119.23	-135.50	-156.73	-177.63	-220.20	-274.92	-323.95
PETROLEUM	-10.05	-11.19	-13.58	-15.74	17.21	-19.37	-21.60	-26.76	-33.60	41.15
NON COMPETITIVE MERCHANDISE	-5.86	-8.69	-10.80	-12.10	-13.62	-15.45	17.26	20.79	25.23	29.32
MARGINS AND SCRAP	7.41	10.22	11.94	13.66	15.42	17.73	20.00	24.63	30.26	32.89
TRAVEL	-4.17	-7.36	-8.51	-9.53	-10.75	-12.09	-13.41	-16.08	-19.65	23.49
PASSENGER FARES, OTH TRANSPORT	-5.32	-5.73	-6.96	-7.82	8.63	-9.73	-10.87	-13.04	-15.90	-10.54
OTHER PRIVATE SERVICES	-1.40	-2.37	-2.83	-3.24	-3.71	-4.29	-4.87	-6.10	-7.60	9.19
INVESTMENT INCOME, NET										
EXPORTS CURRENT DOLLARS										
IMPORTS CURRENT DOLLARS										
INVESTMENT INCOME CUR$, NET										
CAPITAL INFLOWS CUR$, NET										
GOVERNMENT PURCHASES	260.50	334.22	375.10	427.39	473.60	544.46	615.23	747.04	[illegible]	940.76
PUBLIC CONSTRUCTION	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	72.00	89.20	[illegible]
NATIONAL DEFENSE	[illegible]	71.70	[illegible]	[illegible]	[illegible]	94.61	[illegible]	117.44	[illegible]	146.17
NON DEFENSE FEDERAL	31.00	42.63	54.80	67.00	78.99	96.04	113.10	142.02	190.27	103.03
STATE AND LOCAL	149.60	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	414.77	516.36	527.56
EDUCATION	66.20	72.91	[illegible]	[illegible]	[illegible]	102.90	119.90	140.71	[illegible]	[illegible]
PRODUCTIVITY ($1000 PER EMPLOYEE)	14.51	17.09	19.18	20.42	22.22	24.70	27.08	33.20	40.89	47.85
PRIVATE SECTOR	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30.49	[illegible]	[illegible]

TO 2040 FOR [illegible] 4

	1977	1985	1990	1995	2000	2005	2010	2020	2030	2040
[illegible]	92.75	109.05	115.62	119.47	124.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	111.01
[illegible]	74.34	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible].69	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]4
DEFENSE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MILITARY	2.91	2.[illegible]	2.09	[illegible]	[illegible]09	2.09	2.09	2.09	[illegible]	[illegible]09
FIXED WEIGHT [illegible] INDEXES										
WHOLESALE PRICE [illegible] (1967=100)	194.20	407.56	[illegible].40	[illegible]	[illegible]	14[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
INDUSTRIAL [illegible] (1967=100)	19[illegible].10	4[illegible]	672.9[illegible]	[illegible]	[illegible]	14[illegible]	[illegible]	[illegible]	2745.41	[illegible].76
GROSS NATIONAL [illegible] (1972=100)	143.50	287.93	446.88	605.77	764.65	823.54	1082.43	1400.21	1717.90	2003.90
PERSONAL CONSUMPTION EXPEND.	141.60	200.75	429.94	575.74	720.33	877.50	1026.72	[illegible]	[illegible]	1897.04
DURABLE [illegible]	130.40	221.[illegible]	315.[illegible]	400.66	502.61	596.37	690.12	877.63	1065.14	[illegible]
NONDURABLE [illegible]	146.20	283.65	451.72	609.78	[illegible]	925.92	1083.99	1400.12	1716.25	2000.77
SERVICES	141.[illegible]	[illegible]	439.42	[illegible]	[illegible]	[illegible]	[illegible]	1410.[illegible]	1730.31	2010.51
GROSS PRIVATE [illegible] INVESTMENT	151.50	313.[illegible]	[illegible].17	[illegible]	[illegible]	[illegible]	[illegible]	1603.61	1972.00	[illegible]
BUSINESS [illegible]	156.60	324.[illegible]	[illegible].04	765.[illegible]	[illegible]	1086.27	[illegible]	1657.59	2030.47	[illegible]
PRODUCERS [illegible] EQUIPMENT	144.20	[illegible]	[illegible]	652.[illegible]	[illegible].71	1014.74	1195.77	1557.81	1919.89	[illegible]245.74
RESIDENTIAL [illegible]	[illegible]	335.31	[illegible]	764.5[illegible]	805.[illegible]	1073.67	[illegible]	1627.42	1996.59	[illegible]
EXPORTS	[illegible].40	488.22	615.46	881.14	1126.02	[illegible]	[illegible]	[illegible]	[illegible]	3043.11
GOVERNMENT	146.[illegible]	290.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1374.30	1604.14	[illegible]
FEDERAL	145.70	209.73	440.15	[illegible]	[illegible].98	[illegible]	[illegible]	1190.65	[illegible].19	[illegible].14
STATE AND LOCAL	146.60	274.[illegible]	414.11	[illegible].45	[illegible]	[illegible]	[illegible].47	1250.15	1528.82	1779.63
DOMESTIC CRUDE OIL ($/BBL)	8.57	47.44	[illegible].43	[illegible].42	146.42	179.41	[illegible].41	278.79	344.30	403.77
FOREIGN CRUDE OIL ($/BBL)	14.32	49.32	[illegible]	[illegible]	[illegible]	186.53	[illegible].84	289.44	[illegible]	419.79
NATURAL GAS PRICE (1967=100)	388.[illegible]	12[illegible]	[illegible].76	[illegible].42	[illegible]	4720.75	5551.41	7332.73	9074.05	10641.23
AVERAGE COMPENSATION [illegible] (1967=1)	2.11	4.[illegible]	[illegible]	[illegible]	[illegible]	12.45	14.5[illegible]	18.65	22.79	26.51
EXOGENOUS ASSUMPTIONS										
CONSUMPTION										
DISPOSABLE PER CAPITA INCOME 72$	4285.00	5458.00	6200.00	685[illegible]	7645.00	8510.00	9375.00	11085.00	13389.00	15870.00
PCE/DISPOSABLE INCOME	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
POPULATION [illegible] (MILLIONS)	216.82	232.25	24[illegible].58	25[illegible]	259.05	267.32	274.80	289.60	299.80	309.30
SCHOOL [illegible]	57.55	52.11	54.79	59.[illegible]	6[illegible]	62.45	64.20	67.70	70.12	72.[illegible]
PLANT AND EQUIPMENT INVESTMENT										
REAL LONG TERM INTEREST RATE	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
REAL SHORT TERM INTEREST RATE	2.50	3.00	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
HOUSEHOLDS -SERIES B (MILLIONS)	74.60	86.04	91.79	94.37	95.80	100.14	104.40	113.60	117.70	124.00
INVESTMENT TAX CREDIT%	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
CORPORATE TAX RATE%	48.00	44.00	44.00	44.00	44.00	44.00	44.00	44.00	44.00	44.00
FOREIGN TRADE										
AVERAGE FOREIGN CURRENCY PRICE										
EXPORT DEMAND (1972=100)	100.00	132.95	165.23	205.22	254.76	299.52	344.27	433.69	522.99	603.20
DOMESTIC/FOREIGN PRICE(EXPORTS)	100.00	87.54	85.93	83.80	81.42	79.22	76.91	71.86	66.57	61.97
WEIGHTED IMPORT [illegible]	100.00	149.92	171.[illegible]	193.16	[illegible]	255.94	[illegible]	[illegible].14	[illegible].17	[illegible]
FOREIGN/DOMESTIC PRICE (IMPORTS)	100.00	109.11	111.37	115.15	120.[illegible]	1[illegible].56	[illegible]	148.19	[illegible]	195.77
EMPLOYMENT										
LABOR FORCE (MILLIONS)	99.53	115.04	1[illegible].45	125.16	129.75	133.10	136.[illegible]	136.85	138.[illegible]	139.11
CIVILIAN UNEMPLOYMENT RATE	6.98	5.[illegible]	4.87	4.[illegible]	4.40	4.00	4.[illegible]	4.00	3.50	3.06
MULTIPLE JOB AD[illegible] (MIL)	3.91	3.20	3.20	[illegible]	3.20	3.20	3.20	3.20	3.20	3.29
[illegible]	[illegible]	[illegible]	[illegible]97	[illegible]	[illegible]4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table [illegible] (cont'd)

NUMBERS HAVE BEEN SCALED TO 1977, PUBLISHED LEVELS
1 TO 2030 FOR URBSYS: DEC 1 AT 11PM

SUMMARY OF ANNUAL GROWTH RATES

	77 90	77 95	95 139	95 120	120 139	90 139
GROSS NATIONAL PRODUCT	3.63	3.30	2.21	2.34	2.03	2.23
PERSONAL CONSUMPTION EXPENDITURES	3.71	3.45	2.37	2.47	2.23	2.41
DURABLE GOODS	3.85	3.53	2.39	2.54	2.18	2.42
NONDURABLE GOODS	3.32	3.05	2.13	2.13	2.14	2.15
SERVICES	3.99	3.74	2.52	2.69	2.31	2.58
GROSS PRIVATE DOMESTIC INVESTMENT	3.79	3.11	2.08	2.14	2.01	2.01
STRUCTURES	3.32	2.59	1.85	1.70	2.05	1.73
RESIDENTIAL	2.65	1.82	1.52	1.18	1.95	1.33
NON RESIDENTIAL	4.19	3.53	2.16	2.17	2.13	2.12
PRODUCERS' DURABLE EQUIPMENT	4.04	3.55	2.31	2.52	2.04	2.31
AGRICULTURE	3.04	2.66	1.70	1.70	1.70	1.70
MINING	4.06	4.09	3.33	3.71	2.84	3.42
CONSTRUCTION	3.96	3.42	2.00	2.10	1.77	2.01
NONDURABLE GOODS	4.00	3.45	2.19	2.32	2.02	2.12
DURABLE GOODS	4.15	3.50	1.90	2.13	1.78	1.86
TRANSPORTATION	5.34	4.29	1.82	1.91	1.71	1.80
COMMUNICATION	4.78	4.01	2.35	2.57	2.06	2.32
UTILITIES	3.20	3.12	2.47	2.61	2.29	2.52
TRADE	4.21	3.57	2.20	2.30	2.06	2.17
FINANCE AND SERVICES	3.80	3.63	2.37	2.79	1.82	2.43
RESIDENTIAL PDE	5.14	4.54	2.38	2.80	1.82	2.44
INVENTORY CHANGE	5.20	3.52	1.78	1.98	1.51	1.50
EXPORTS OF GOODS AND SERVICES	5.63	4.67	1.82	1.84	1.70	1.85
MERCHANDISE	5.88	4.83	1.74	1.74	1.73	1.77
MARGINS AND SCRAP	5.54	4.57	1.71	1.71	1.21	1.35
TRAVEL	4.12	3.63	2.15	2.21	2.07	2.16
PASSENGER FARES, OTH TRANSPORT	2.90	2.87	2.10	2.29	1.84	2.17
OTHER PRIVATE SERVICES	5.70	4.98	2.45	2.66	2.18	2.31
IMPORTS OF GOODS AND SERVICES	4.16	3.77	2.23	2.40	2.01	2.28
MERCHANDISE	4.08	3.74	2.27	2.45	2.03	2.33
PETROLEUM	2.32	2.49	2.18	2.12	2.26	2.26
NON COMPETITIVE MERCHANDISE	4.70	4.03	2.01	2.16	1.81	2.34
MARGINS AND SCRAP	3.67	3.40	2.20	2.36	1.98	2.25
TRAVEL	5.48	4.59	2.05	2.09	2.00	2.07
PASSENGER FARES, OTH TRANSPORT	2.06	2.14	1.96	2.04	1.85	2.00
OTHER PRIVATE SERVICES	5.40	4.65	2.37	2.54	2.16	2.41
INVESTMENT INCOME, NET						
EXPORTS CURRENT DOLLARS						
IMPORTS CURRENT DOLLARS						
INVESTMENT INCOME CUR$, NET						
CAPITAL INFLOWS CUR$, NET						
GOVERNMENT PURCHASES	2.65	2.58	1.81	2.23	1.26	1.87
PUBLIC CONSTRUCTION	2.70	2.54	1.83	2.29	[illegible]	[illegible]
NATIONAL DEFENSE	[illegible]	1.56	[illegible]	[illegible]	[illegible]	[illegible]
NON DEFENSE FEDERAL	4.3[illegible]	4.28	2.20	[illegible]	[illegible]	[illegible]
STATE AND LOCAL	2.61	2.56	1.82	2.23	1.27	1.88
EDUCATION	1.30	1.55	1.27	1.09	[illegible]	[illegible]
PRODUCTIVITY ($1000 PER EMPLOYEE)	1.94	1.90	1.93	1.94	1.82	1.92
PRIVATE SECTOR	1.97	1.97	2.04	2.06	2.00	2.03

Table 1-3 (Cont'd)

1 TO 2039 FOR URBSYS: DEC 1 AT 11PM

SUMMARY OF ANNUAL GROWTH RATES

	77-80	77-85	95-139	95-120	120-139	90-139
EMPLOYED PERSONS (MILLIONS)	1.70	1.40	0.26	0.38	0.10	0.30
PRIVATE INDUSTRY	1.99	1.59	0.25	0.37	0.09	0.20
CIVILIAN GOVERNMENT	0.85	0.82	0.34	0.46	0.17	0.42
DEFENSE	-0.67	-0.48	0.00	0.00	0.00	0.00
MILITARY	-2.55	-1.84	0.00	0.00	0.00	0.00
0 FIXED WEIGHT PRICE INDEXES						
WHOLESALE PRICE INDEX (1967=100)	9.47	8.66	2.82	3.49	1.93	3.20
INDUSTRIAL COMPONENT(1967=100)	9.52	8.69	2.81	3.40	1.93	3.19
GROSS NATIONAL PRODUCT(1972=100)	8.74	8.00	2.72	3.35	1.89	3.08
PERSONAL CONSUMPTION EXPEND.	8.54	7.83	2.69	3.31	1.87	3.02
DURABLE GOODS	8.79	6.35	2.41	3.06	1.79	2.79
NONDURABLE GOODS	8.60	7.93	2.70	3.32	1.88	3.04
SERVICES	8.91	8.13	2.72	3.35	1.89	3.07
GROSS PRIVATE FIXED INVESTMENT	9.16	8.36	2.77	3.42	1.91	3.13
BUSINESS STRUCTURES	9.18	8.36	2.77	3.42	1.91	3.13
PRODUCERS DURABLE EQUIPMENT	9.12	8.39	2.81	3.40	1.92	3.18
RESIDENTIAL CONSTRUCTION	9.10	8.28	2.72	3.35	1.88	3.08
EXPORTS	9.64	8.78	2.82	3.49	1.93	3.20
GOVERNMENT	8.48	7.78	2.69	3.31	1.88	3.03
FEDERAL	8.64	7.92	2.71	3.34	1.88	3.05
STATE AND LOCAL	7.83	7.27	2.65	3.26	1.86	2.98
0DOMESTIC CRUDE OIL ($/BBL)	17.22	14.35	2.89	3.59	1.96	3.29
FOREIGN CRUDE OIL ($/BBL)	13.57	11.71	2.89	3.59	1.96	3.29
NATURAL GAS PRICE (1967=100)	13.02	11.32	2.89	3.60	1.96	3.30
0AVERAGE COMPENSATION/HOUR (1867=1)	8.35	7.62	2.63	3.23	1.85	2.95
0						
0 EXOGENOUS ASSUMPTIONS						
0 CONSUMPTION						
DISPOSABLE PER CAPITA INCOME 72$	2.84	2.61	1.91	1.92	1.89	1.92
PCE/DISPOSABLE INCOME	-0.00	-0.00	0.00	0.00	-0.00	0.00
POPULATION - SERIES II (MILLIONS)	0.88	0.84	0.46	0.55	0.35	0.49
SCHOOL AGE POPULATION	-0.38	0.14	-0.46	-0.65	0.06	0.67
PLANT AND EQUIPMENT INVESTMENT						
REAL LONG-TERM INTEREST RATE						
REAL SHORT-TERM INTEREST RATE	-0.00	-0.00	0.00	-0.00	0.00	0.00
HOUSEHOLDS - SERIES B (MILLIONS)	1.39	1.30	0.62	0.74	0.46	0.61
INVESTMENT TAX CREDIT:%						
CORPORATE TAX RATE:%	-0.67	-0.48	0.00	0.00	0.00	0.00
FOREIGN TRADE						
AVERAGE FOREIGN CURRENCY PRICE						
EXPORT DEMAND (1976=100)	3.86	3.99	2.45	2.89	1.74	2.64
DOMESTIC/FOREIGN PRICE(EXPORTS)	-1.17	-0.90	-0.69	-0.62	-0.78	0.67
WEIGHTED IMPORT DEMAND	4.14	3.66	[illegible]	2.49	2.09	2.32
FOREIGN/DOMESTIC PRICE(IMPORTS)	0.83	0.70	1.21	1.01	1.47	1.15
EMPLOYMENT						
LABOR FORCE (MILLIONS)	1.53	1.27	0.24	0.36	0.09	0.28
CIVILIAN UNEMPLOYMENT RATE	-2.77	-2.21	-0.44	-0.55	-0.30	-0.47
MULTIPLE JOB ADJUSTMENT (MIL)	1.54	1.11	0.00	0.00	0.00	0.00
INDEX OF AVERAGE WORK WEEK	0.10	-0.17	-0.20	-0.21	.18	-0.21

Table I-4

ALLOCATION OF TOTAL CONSTRUCTION COSTS TO PUBLIC CONSTRUCTION (PC) SECTOR 24, AND EQUIPMENT PURCHASING (EQ) SECTOR 66, BY LOCK, 1980-89 AND 1983-90

(Thousands of October 1981 Dollars)

	(1) 1983-1990	(2) 1980-1989
Bouldin		
PC	246,320	251,108
EQ	22,211	22,211
Total	268,531	273,319
Mitchell		
PC	131,579	134,205
EQ	14,685	14,685
Total	146,264	148,890
Lay		
PC	160,672	163,843
EQ	16,083	16,083
Total	176,755	179,926
Logan Martin		
PC	285,947	291,361
EQ	15,948	15,948
Total	301,895	307,309
Neely Henry		
PC	224,117	228,319
EQ	11,209	11,209
Total	235,326	239,528

The GDM breaks down the $1.15 billion (October 1981 dollars) cost of the project into approximately 150 line items for each lock. This breakdown was used to identify equipment purchases. Equipment is defined as premanufactured items which are installed without major modification, ie., they are not significantly shaped, cut, or formed before installation at the lock site. Construction materials or supplies are not classified as equipment. This definition of equipment is used by INFORUM and by the MRMI model, and is consistent with the definition provided in the PLANTEC document.

Each line item listed in the GDM for each lock was reviewed to determine whether it was an equipment item, in which case the cost for that item was allocated to the equipment purchasing sector. All other line items were allocated to the public construction sector. Thus, for example, the upper miter gate, electric and hydraulic systems, and permanent operating equipment all were classified as equipment; construction materials such as handrailing, grating, steel reinforcement, or bypass piping are not equipment, although they may be premanufactured.

Once total equipment purchases for each lock were calculated, the remainder of the total construction cost was allocated to the public construction sector. This allocation of costs is shown on Table I-4, column 2. The initial allocation of costs to the two sectors is the basis of later allocations of cost by year and by county.

I.3.1 Early Construction Impacts

The schedule of funds in the GDM (Table I-1) indicates expenditures in 1980, 1981, and 1982 for the Coosa River project. Because construction does not begin until 1983 (at Walter Bouldin), earlier planning and design costs were treated separately. These costs were allocated to each of the five locks based on the total construction cost of each lock relative to the total cost of the entire Coosa River project (Table I-5). For example, the cost of Mitchell lock is 13 percent of the entire cost of the Coosa River Project; therefore, 13 percent of the 1980 planning and design costs were allocated to Mitchell lock. This calculation was repeated for each lock for 1980 through 1982.

This study assumed that these early construction costs are not equipment purchases. Therefore, 1980-1982 costs were subtracted only from the public construction component of the total costs at each lock in order to derive the remaining 1983-1990 project costs. This adjustment is shown in Table I-4, Columns 1 and 2.

I.3.2 Allocation of Costs to Counties

The impact area for each lock was defined as the three or four counties adjacent to the site of the lock. This impact area definition is consistent with PLANTEC's conclusions that the wave of impact for each project "would be expected to encompass approximately a four-county area around each construction site;"

Table I-5

I. ALLOCATION OF EARLY CONSTRUCTION COSTS (1980-1982) AMONG THE FIVE LOCKS

Lock	1980-89 Construction Costs	Percent of Total Project
Bouldin	$ 273,000,000	23.7%
Mitchell	149,000,000	13.0%
Lay	180,000,000	15.7%
Logan Martin	307,000,000	26.8%
Neely Henry	240,000,000	20.8%
TOTAL	$1,149,000,000	100.0%

II. ALLOCATION OF EARLY CONSTRUCTION COSTS BY YEAR BY LOCK

Lock	1980	1981	1982	Total
Bouldin	1,256,100	1,635,300	1,896,000	4,787,400
Mitchell	689,000	897,000	1,040,000	2,626,000
Lay	832,100	1,083,000	1,256,000	3,171,400
Logan Martin	1,420,400	1,849,200	2,144,000	5,413,600
Neely Henry	1,102,400	1,435,200	1,664,000	4,201,600
	5,300,000	6,900,000	8,000,000	20,200,000

that "80 percent of construction workers already reside in the ten-county region;" and that an additional fifteen percent will move into the region.[1]

Having assumed that the impact area is the 3 or 4 counties nearest each lock, construction expenditures were allocated to each county based on the relative 1980 populations of each (Table I-6).

In addition to allocating costs by county, 1983-1990 construction costs were allocated by year. Public construction and equipment purchases were treated separately for this allocation.

I.3.3 Public Construction

The allocation of public construction impacts was based on the planned construction schedule in the GDM and in the PLANTEC document (Figure I-2). PLANTEC has estimated that, for the "typical lock", construction may be divided into 3 stages:

- preparatory
- peak construction
- finalization.

PLANTEC also estimated that the percentage of labor at each lock attributable to each construction stage was 22%, 66% and 12% respectively.

---

[1]PLANTEC Corporation, Coosa River Navigation Project. Prepared for U.S. Corps of Engineers, October 1981.

Table I-6

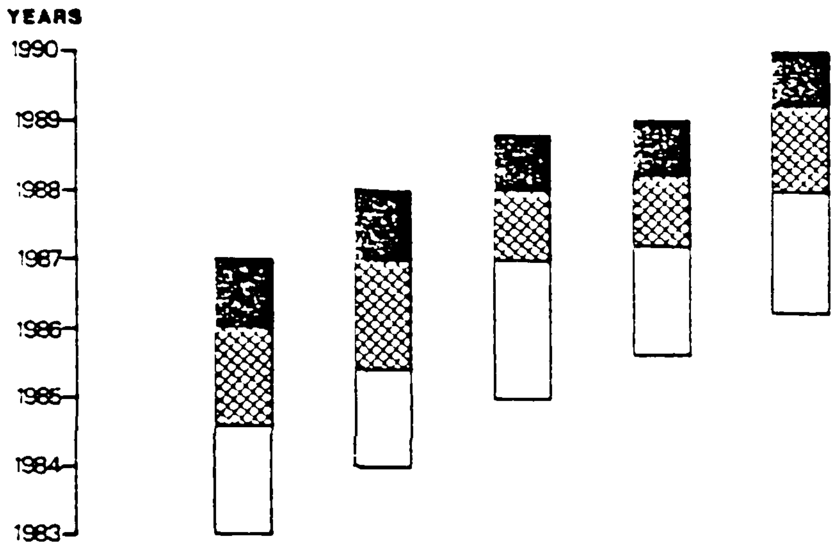
ALLOCATION OF CERTAIN DAM COSTS TO INDIVIDUAL COUNTIES

Dam	Percentage of Cost Allocated to the County
BOULDIN	
Autauga	11.3
Montgomery	72.6
Elmore	16.1
MITCHELL	
Autauga	26.1
Elmore	37.4
Chilton	26.4
Coosa	10.1
LAY	
Chilton	17.2
Coosa	6.6
Shelby	36.0
Talladega	40.2
LOGAN MARTIN	
Shelby	36.8
Talladega	41.0
St. Clair	22.2
H. NEELY HENRY	
Etowah	30.5
St. Clair	11.6
Calhoun	36.5
Talladega	21.4

Source: Rand McNally, 1981 Commercial Atlas.
The percentage allocations are based on the relative 1980 populations of each county.

FIGURE I-2

PLANNED CONSTRUCTION SCHEDULE: COOSA RIVER NAVIGATION PROJECT



LOCKS	W. Bouldin	Mitchell	Lay	L. Martin	H.N. Henry
CONSTRUCTION					
Begin	7/83	7/84	7/85	4/86	1/87
End	6/87	6/88	3/89	12/89	9/90
Years	4.0	4.0	3.75	3.75	3.75
PERIODS	Preparatory (1st 18 months) Peak (mid 18 months) Finalization (last 9-12 months)				

Source: PLANTEC Corporation, Coosa River Navigation Project. Prepared for U.S. Corps of Engineers, October 1981, Figure III-10.

These labor percentages were applied to the 1983-1990 public construction impacts to calculate the cost of each phase. These costs were then allocated by year based on the start date of the project (Figure I-2) and the duration (in months) of each construction stage.

According to Figure I-2, the preparatory stage comprises the first 18 months of the project; the peak construction stage comprises the next 18 months; and finalization comprises the last 9 or the last 12 months, depending on whether construction is expected to last 3.75 (Lay, Logan Martin, H. Neely Henry) or 4 years (Walter Bouldin, Mitchell). The total public construction cost for each stage was divided by the number of months per stage to estimate the cost per month. This step was required in order to apportion costs to each year; some construction stages covered parts of three different years.

After costs were allocated by year, the totals for each county were added to the baseline forecast estimates for Public Construction Sector 24: Water Systems. The percentage of public construction impacts by year is shown in Table I-7 and Figure I-3. The final distribution of public construction impacts (in 1981 dollars) by county and year is shown in Table I-8.

I.3.4 Equipment Purchases

Equipment purchases were assumed to occur in the last 21 or 24 months of the project, depending on whether the construction of the

TABLE I-7

ESTIMATED PERCENTAGE OF PUBLIC CONSTRUCTION IMPACTS BY YEAR

	Annual Percentage	Cumulative Percentage
1983	1.7	1.7
1984	4.4	6.1
1985	13.3	19.4
1986	17.3	36.7
1987	20.8	57.5
1988	23.6	81.1
1989	16.3	97.4
1990	2.6	100.0
	100.0	

FIGURE I-3

ESTIMATED PERCENTAGE OF PUBLIC CONSTRUCTION IMPACTS BY YEAR

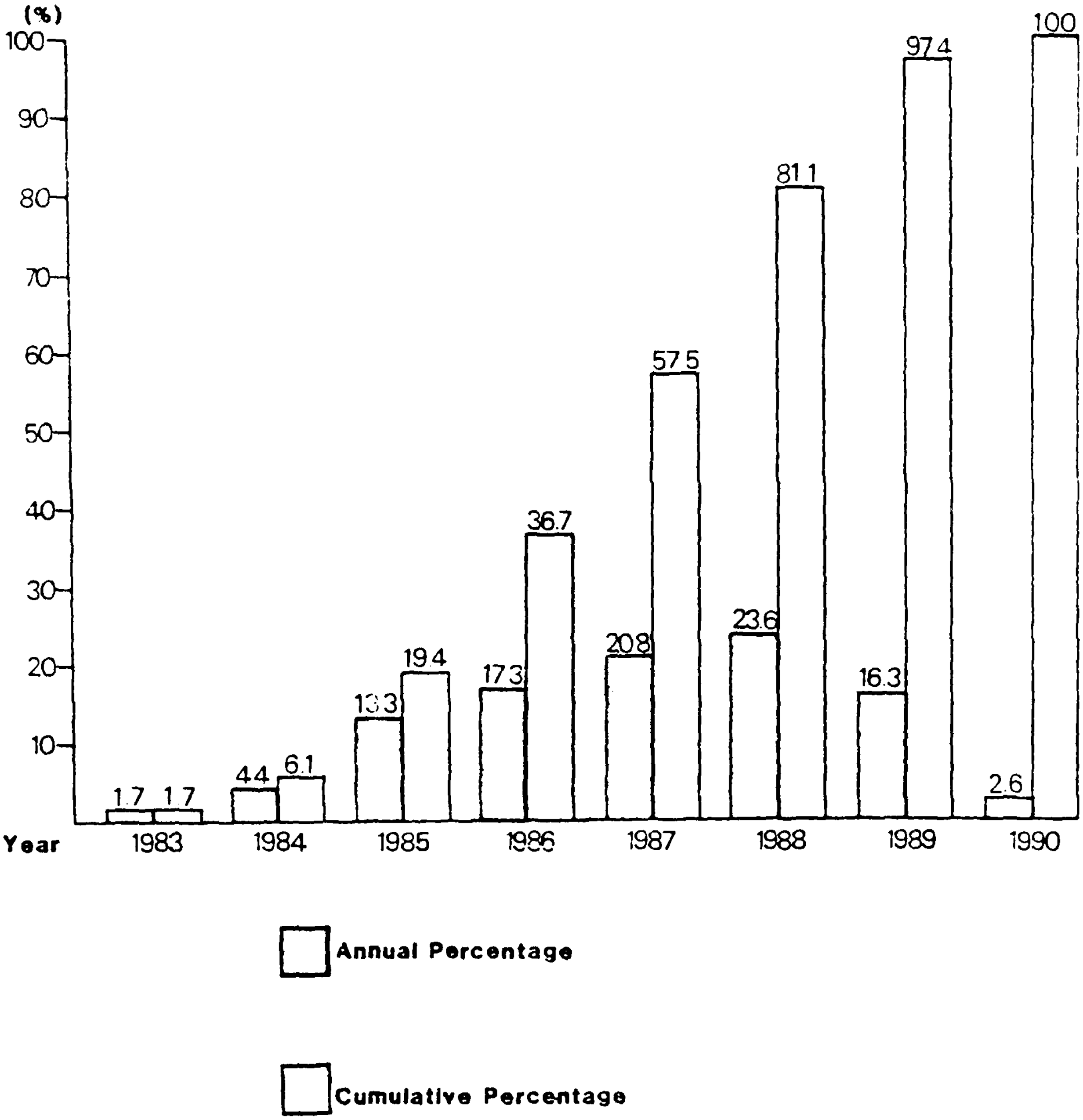


Table I-8

IMPACTS ON PUBLIC CONSTRUCTION SECTOR 24,

WATER SYSTEMS

(Thousands of 1981$)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Montgomery County	909	1,183	1,372	13,064	26,127	78,381	49,878	10,689	0	0	0
Elmore County	458	596	691	2,897	9,389	24,571	32,630	16,096	2,941	0	0
Autauga County	320	417	484	2,034	6,575	17,218	22,816	11,242	2,052	0	0
Coosa County	124	161	187	0	970	2,716	7,374	8,354	3,963	423	0
Chilton County	323	421	489	0	2,538	7,095	19,262	21,802	10,335	1,100	0
Talladega County	1,148	1,494	1,733	0	0	4,719	22,283	61,010	84,703	50,456	5,734
Shelby County	818	1,067	1,237	0	0	4,225	19,981	48,413	63,408	26,414	0
Calhoun County	402	521	605	0	0	0	0	11,952	23,903	35,855	9,778
St. Clair County	441	575	667	0	0	0	6,957	17,710	35,421	25,938	3,108
Etowah County	334	437	506	0	0	0	0	9,907	19,973	24,960	8,171

lock lasted 3.75 or 4 years. The rationale for this assumption is that the finalization phase consists "primarily (of) the installation of pre-manufactured items " (PLANTEC) ie., equipment, and that prior to the finalization phase, equipment would not be purchased or installed until the latter part of the peak construction phase. No major equipment purchases occur during the preparatory stage.

Total equipment purchases at each site were divided by the number of months over which these purchases were expected to occur (either 21 or 24 months) to calculate costs per month. Costs were then distributed to each year; allocated to each county by year; summed for each county; and added to Equipment Purchasing Sector 66: Buses, Waterways, and Pipelines. The percentage of equipment purchases by year is shown in Table I-9 and Figure I-4. The resulting direct impacts input to MRMI are given in Table I-10.

I.4 Operation, Maintenance, and Equipment Replacement Impacts

The Mobile office of the Corps of Engineers supplied October 1981 estimates of operation, maintenance and equipment replacement costs. These costs (Tables I-11 and I-12) were allocated as shown in Table I-13. The costs for Mobile office personnel were allocated to Federal Government Expenditures Sector 11: Water Transportation. The impact area for these Mobile office personnel costs is Baldwin and Mobile counties; the costs were divided between the two counties based on the relative 1980 populations of each.

Table I-9

ESTIMATED PERCENTAGE OF EQUIPMENT PURCHASES

(CONSTRUCTION PHASE) BY YEAR

	Annual Percentage	Cumulative Percentage
1985	6.9	6.9
1986	18.4	25.3
1987	21.8	47.1
1988	24.7	71.8
1989	22.2	94.0
1990	6.0	100.0
	100.0	

FIGURE I-4

ESTIMATED PERCENTAGE OF EQUIPMENT PURCHASES (CONSTRUCTION PHASE) BY YEAR

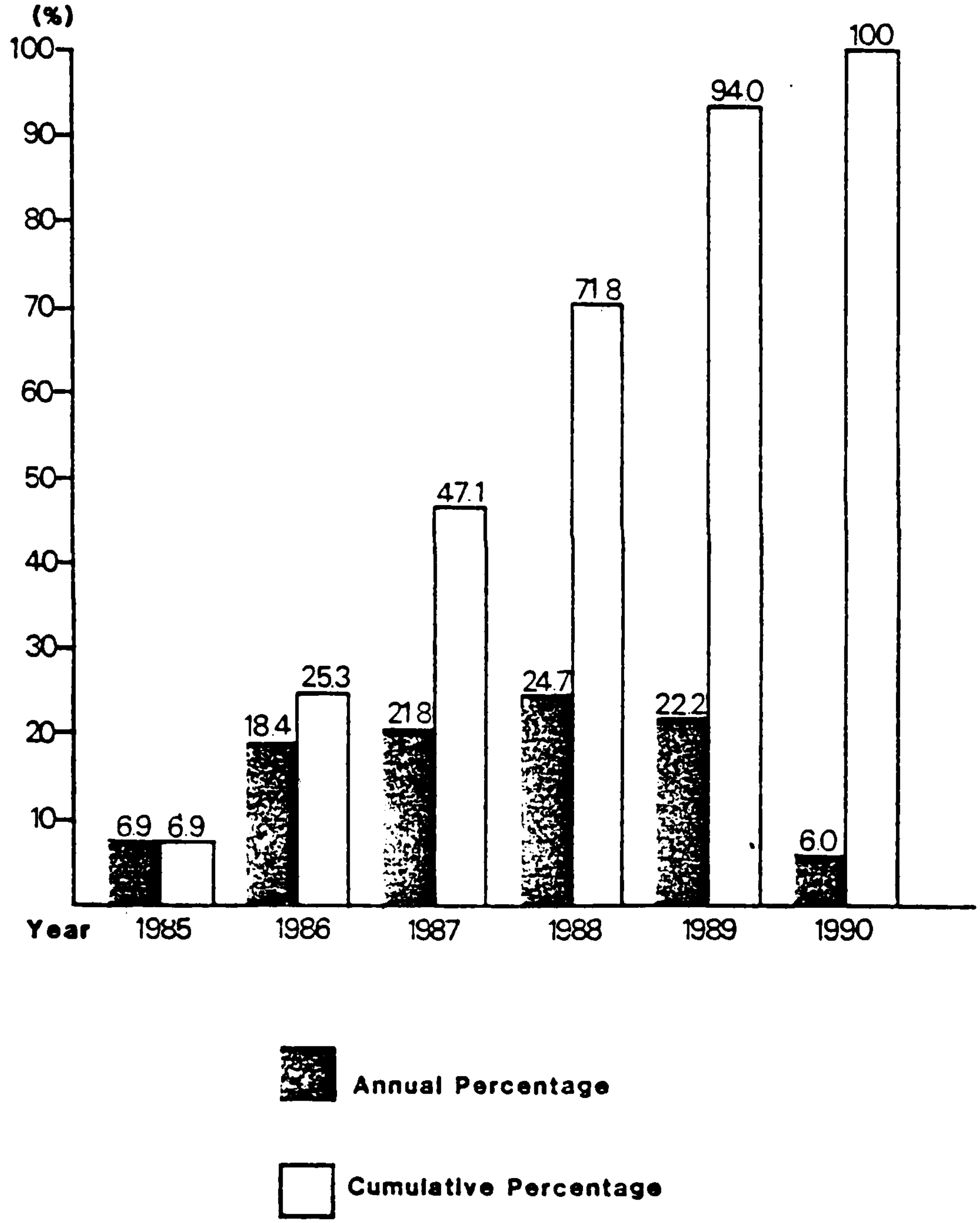


Table I-10

IMPACTS ON EQUIPMENT PURCHASING SECTOR 66,

BUSES, WATERWAYS, AND PIPELINES

(Thousands of 1981$)

	1985	1986	1987	1988	1989	1990	1991 - 2039
Montgomery Cty.	4,016	8,031	4,032	34	34	34	34...34
Elmore County	890	3,150	3,629	1,384	25	25	25...25
Autauga County	625	2,204	2,537	966	17	17	17...17
Coosa County	0	369	1,041	976	158	8	8...8
Chilton County	0	966	2,719	2,546	412	20	20...20
Talladega County	0	0	1,841	6,471	6,022	1,064	48...48
Shelby County	0	0	1,648	5,801	4,176	34	34...34
Calhoun County	0	0	0	0	2,330	1,750	17...17
St. Clair County	0	0	0	1,511	2,756	567	15...15
Etowah County	0	0	0	0	1,946	1,464	15...15

Table I-11

ANNUAL OPERATION, MAINTENANCE, AND REPLACEMENT COSTS

(October 1981 $)

Personnel Costs	$1,467,000
Maintenance and supplies	
Buildings, grounds and utilities	310,000
Ordinary maintenance	50,000
Major painting	460,000
Maintenance dredging	1,222,000
Operation support costs	218,000
Major replacements	230,000
TOTAL	$3,955,000

Table I-12

SUMMARY OF MAJOR REPLACEMENTS

Item	Annual Cost
Mechanical equipment	$ 15,200
Communication equipment	35,100
Permanent operating equipment	143,200
Office & shop equipment	36,000
TOTAL	$ 230,100

Table I-13

ALLOCATION OF 1990-2039 OPERATION MAINTENANCE,

AND REPLACEMENT COSTS

3,955,000	Annual Total
- 340,000	Mobile Office Personnel
3,615,000	Subtotal
- 230,000	Equipment Purchases. Divided equally among each of the 5 locks = $46,000 per lock per year.
3,385,000	Personnel, Maintenance and Supplies, Operation Support. Divided equally among each of the 5 locks = $677,000 per lock per year.

NOTE: Because H. Neely Henry will not be compeleted until the end of September 1990, only one-quarter of the above costs (46,000/4 and 677,000/4) will be incurred at that lock in 1990.

Costs for equipment replacement were allocated to Equipment Purchasing Sector 66: Buses, Waterways, and Pipelines (Table I-10). Costs for personnel, maintenance and supplies, and operation support were allocated to Federal Government Expenditures Sector 11: Water Transportation. Those costs which were allocated to each lock (i.e., all costs except Mobile office personnel) were then allocated to each county based on the allocation scheme used for construction impacts (Table I-14).

Costs for Mobile office personnel were assumed to be incurred starting in 1980. In addition, operation, maintenance, and equipment replacement costs at some of the locks will be incurred before 1990. Construction at Walter Bouldin will be completed by 30 June 1987; at Mitchell by 30 June 1988; and at Lay by 31 March 1989. Therefore, the annual costs at each lock (Table I-13) from 1990 to 2039 were also allocated to previous years in the case of these three locks. Since construction at these three locks is expected to be completed in March or June--rather than at the end of the year--the operation, maintenance, and equipment replacement costs have been reduced proportionately in the year in which construction ends.

At Neely Henry, construction is not completed until 30 September 1990. Therefore, operation, maintenance, and replacement costs for 1990 at that lock have been reduced by 75 percent.

I.5 Transportation Cost Impacts

The MRMI model relocates production to regions showing the

Table I-14

IMPACTS ON GOVERNMENT EXPENDITURES SECTOR 11,

WATER TRANSPORTATION

(Thousands of 1981$)

	1987	1988	1989	1990	1991-2039
Montgomery County	245	489	489	489	489...489
Elmore County	54	234	360	360	361...361
Autauga County	38	164	253	253	253...253
Coosa County	0	34	101	112	113...113
Chilton County	0	89	265	294	295...295
Talladega County	0	0	204	584	692...692
Shelby County	0	0	182	490	491...491
Calhoun County	0	0	0	61	247...247
St. Clair County	0	0	0	169	229...229
Etowah County	0	0	0	52	206...206

	1981	1982-2039
Mobile	279	279...279
Baldwin	60	60...60

lowest production and transportation costs. Thus, regions with relative cost advantages in one year will attract new industries and have higher production costs in the next year. This, in turn, will influence transportation costs, relative production costs and supply and demand for commodities in the regions. Transportation costs are incorporated into output equations through shadow prices, which are the dual variables of a classical linear programming transportation problem. These shadow prices, when combined with an average wage rate variable, constitute location rent, one of several independent variables in industry output equations. To characterize transportation cost savings associated with the waterway, therefore, the linear programming sub-model must be re-solved using a revised interregional cost matrix.

In this submodel, there are three components of each transportation cost estimate for shipping a commodity from region i to region j. Costs are represented by the equation:

$${}_kC^w_{ij} = {}_kTER^w_i + {}_kLH^w_{ij} + {}_kTER^w_j$$

where:

${}_kC^w_{ij}$ = total cost to carriers of shipping a unit bundle in weight class w between areas i and j by mode of transportation k

${}_kTER^w_i$ = terminal cost at i; includes expenses of pickup and delivery

${}_kLH^w_{ij}$ = line haul cost between i and j; includes expenses of transporter while shipment is in transit

${}_kTER^w_j$ = terminal cost at j; includes expenses of pickup and delivery.

Costs are aggregated over weight classes and modes to yield aggregate transportation rates.[1] Then, given these shipping rates between regions, marginal transportation costs can be calculated for each commodity using the linear programming algorithm that minimizes the total shipping costs for that commodity. If a region has comparatively lower transportation costs due solely to its location, the marginal transportation cost variables from the transportation submodel will reflect this. With construction of the Coosa River Navigation Project, commodities currently shipped by more expensive modes such as truck and rail will be transported by a less expensive mode, i.e., barge. This change in rates will, in turn, produce lower marginal transportation costs.

The data used to calculate transportation rates were developed from a traffic survey conducted by the Mobile District of the Corps of Engineers in January, 1979. Shipments were summarized by origin-destination and by commodity group for ten year intervals through 2039, with transportation rates given for moving the commodities to their destinations via the current mode, i.e., rail or truck, and by the new mode barge on the waterway.

Rates for barge, truck and rail used in the submodel are aggregations of the different rates charged for the different modes, as described above. To satisfy input requirements of the linear programming model, several changes were made to the rates provided by the Corps. First, the differentials between transportation rates before and after the waterway is opened, expressed in dollars per

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[1] U.S. Department of Commerce, Bureau of Economic Analysis, BEA Economic Areas, revised 1977: Component SMSAs, Counties and Independent Cities Washington, DC: U.S. Government Printing Office, 1978.

ton, were recalculated in terms of cents per 100 pounds. Second, since the linear programming model estimates the marginal costs of shipping from region to region based on the 183 area classification developed by the Bureau of Economic Analysis, county origins and destinations were mapped into the appropriate BEA region. This procedure yielded a set of rate differentials expressed in cents per 100 pounds between all BEA economic regions encompassing the origin-destination pairs identified in the Corps traffic survey. The rate differentials are shown in Table I-15. Finally, these differentials were deflated to 1972 dollars using national wholesale price indicies for the relevant commodity sectors. These were subsequently subtracted from baseline rates in the transportation cost matrix to represent the transportation cost impacts of the navigation project.[1]

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[1]Note that in some cases, there were several rate differentials for the same commodity and set of trading partners. For example, if there existed a differential between truck transportation and barge in addition to a rate differential between rail and barge, these differentials had to be aggregated. This aggregation was performed using a weighted average based on the tonnage being shipped.

As an illustration, consider a hypothetical case where iron ore is shipped between Gadsden and Mobile, but by different modes, rail and truck. Once the project is completed, iron ore will be shipped by barge in both cases, but the differentials between current modes and the barge rate are not the same. If iron ore is presently shipped by rail at a cost of $3.00/ton, but after the project is completed, shipment of the same commodity by barge is expected to cost $1.00/ton, the rate differential is $2.00/ton. For truck and barge, suppose the differential is $4.00/ton. To aggregate these differentials for this particular set of trading partners, then, each differential is weighted according to the number of tons being transported: 600 tons will be switching from rail to barge at the $2.00/ton difference, where 1400 tons will be shipped by barge rather than truck. The equation becomes.

$$.3(\$2.00) + .7(\$4.00) = \$3.40 \text{ differential.}$$

Table I-15

TRANSPORTATION COST DIFFERENTIALS INCORPORATED INTO INTERREGIONAL COST MATRIX OF LINEAR PROGRAMMING SUB-MODEL

	Origin		Destination		
MIMI Sector	BEA Code[1]	Economic Area Name	BEA Code[2]	Economic Area Name	Cost Differential
3. Forestry	47	Mobile, AL-MS	49	Birmingham, AL	.09
5. Iron & Ferroalloy Ores Mining	49	Birmingham, AL	47	Mobile, AL-MS	.03
7. Coal Mining	51	Chattanooga, TN-GA-AL	47	Mobile, AL-MS	.02
	51	Chattanooga, TN-GA-AL	113	New Orleans, LA-MS	.02
8. Crude Petroleum & Natural Gas	47	Mobile, AL-MS	49	Birmingham, AL	.02
9. Stone, Clay Chemical & Fertilizer Mining	49	Birmingham, AL	16	Pittsburgh, PA-MD-WV	.20
	49	Birmingham, AL	46	Pensacola-Panama City, FL	.01
	49	Birmingham, AL	47	Mobile, AL-MS	.06
	49	Birmingham, AL	83	Chicago, IL-IN	.09
	49	Birmingham, AL	89	Milwaukee, WS	.13
	49	Birmingham, AL	105	Kansas City, MO-KS	.13
	49	Birmingham, AL	107	St. Louis, MO-IL	.01
	49	Birmingham, AL	113	New Orleans, LA-MS	.08
	49	Birmingham, AL	122	Houston, TX	.11
	48	Montgomery, AL	46	Pensacola-Panama City, FL	.03
	48	Montgomery, AL	47	Mobile, AL-MS	.03
	48	Montgomery, AL	49	Birmingham, AL	.04

[1] Counties comprising BEA economic areas are given in Appendix III

[2] Cents per 100 pounds in 1972 dollars.

Table I-15 (Cont'd)

TRANSPORTATION COST DIFFERENTIALS INCORPORATED INTO INTERREGIONAL COST MATRIX OF LINEAR PROGRAMMING SUB-MODEL

MIMI Sector	Origin BEA Code[1]	Origin Economic Area Name	Destination BEA Code[2]	Destination Economic Area Name	Cost Differential
	131	Brownsville-McAllen -Harlington, TX	49	Birmingham, AL	.10
28. Plastics & Synthetics	121	Beaumont-Port -Arthur, TX	49	Birmingham, AL	.06
	122	Houston, TX	51	Chattanooga, TN-GA-AL	.05
34. Petroleum Refining	113	New Orleans, LA-MS	36	Atlanta, GA	.02
	121	Beaumont-Port -Arthur, TX	49	Birmingham, AL	.04
	122	Houston, TX	49	Birmingham, AL	.04
39. Stone, Clay	48	Montgomery, AL	49	Birmingham, AL	.03
& Glass Products	49	Birmingham, AL	46	Pensacola-Panama City, FL	.03
	49	Birmingham, AL	113	New Orleans, LA-MS	.01
40. Iron & Steel	16	Pittsburgh, PA-MD-WV	49	Birmingham, AL	.05
	49	Birmingham, AL	46	Pensacola-Panama City, FL	.07
	49	Birmingham, AL	47	Mobile, AL-MS	.12
	49	Birmingham, AL	48	Montgomery, AL	.06
	49	Birmingham, AL	113	New Orleans, LA-MS	.08
	49	Birmingham, AL	122	Houston, TX	.22
41. Copper	49	Birmingham, AL	47	Mobile, AL-MS	.06

[1]Counties comprising BEA economic areas are given in Appendix III

[2]Cents per 100 pounds in 1972 dollars.

I.6 Impacts on Output for Rail, Truck and Barge Carriers

Operation of the waterway is expected to decrease output (or revenues) of rail and truck carriers in the region while increasing output for water transporters. To incorporate these changes, data from the traffic survey undertaken by the Mobile District of the Corps were used to determine initial direct impacts on output for MRMI sectors:

88: Railroad Transportation

90: Trucking and Warehousing

91: Water Transportation[1]

The objective was to calculate the difference in revenues earned by each of these industries as a result of the project construction and subsequent use of the waterway. Since the data were provided in ten year intervals from 1990 to 2030, with a nine year interval to 2039, intervening estimates of tonnage traveling on the river were calculated by linear interpolation. The tonnages were then aggregated by destination, since it was assumed that shipping costs were paid at destination (FOB pricing). At this point, tonnages were multiplied by rates for both pre-project and

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[1]In some cases the mode of transportation was a barge/truck combination. Because it was impossible to accurately separate out the revenues for each, all output was assigned to sector 91 (Water Transportation).

Whereas this is expected to bias water transportation output upward in the region, and bias trucking and warehousing output downard, it is unlikely to bias regional profitability, ie. the location rent term.

post-project shipping modes to obtain revenues for each carrier, before and after project completion. The revenues were then deflated to 1976 dollars and aggregated by destination to derive direct impact estimates by county (Table I-16). Finally, these impacts were subtracted from the appropriate sectors and regions as the impact forecast was run to incorporate the direct effects of the navigation project on revenues of the major transportation modes.

I.7 Impacts on Power Generation and Revenues

It is assumed "that all water used for lockages is lost for power generation for the percentage of time flows are at or below turbine capacity" (GDM, October 1981). This power generation loss results in a reduction in the gross revenues of Alabama Power Company. Gross revenues correspond to output in Sector 70, "Electric Utilities"; therefore, a reduction in revenues represents a reduction in regional outputs in that sector.

The calculation of average annual power loss at each lock was based on data provided by the Mobile office in the October 1981 GDM, paragraphs 158 and 159. These paragraphs contain estimates of day-second feet lost to power generation at each lock (Table I-17). Also estimated are daily lockages at each of the locks; the Corps assumes that these lockages will increase between 1990 and 2039 (Table I-18).

Table 1-16

IMPACTS ON OUTPUT SECTOR 88, RAILROAD TRANSPORTATION[1]
(Thousands of 1981 $)

County	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Etowah, AL	9,444	9,580	9,713	9,871	9,905	10,121	10,252	10,388	10,523	10,659	10,800	10,974	11,147	11,322	11,491	11,670	11,842	12,016	12,190
Mobile, AL	19,850	20,167	20,403	20,799	21,117	21,431	21,740	22,064	22,381	22,696	23,014	23,353	23,691	24,030	24,369	24,708	25,047	25,388	25,728
Shelby, AL	67	69	69	69	70	72	71	73	75	75	76	77	77	77	79	80	80	80	82
Bay, FL	2,713	2,808	2,903	2,998	3,093	3,187	3,283	3,378	3,472	3,568	3,661	3,765	3,869	3,971	4,075	4,179	4,281	4,385	4,481
Escambia, FL	1,299	1,324	1,350	1,376	1,401	1,427	1,454	1,480	1,505	1,530	1,556	1,591	1,625	1,658	1,692	1,726	1,759	1,793	1,826
Gulf, FL	5,029	5,050	5,331	5,483	5,634	5,784	5,936	6,088	6,239	6,389	6,541	6,661	6,866	7,029	7,191	7,354	7,517	7,679	7,842
Jackson, MS	2,471	2,528	2,585	2,642	2,699	2,756	2,813	2,870	2,927	2,984	3,041	3,103	3,168	3,232	3,298	3,362	3,426	3,489	3,551
Rest-of-Nation	4,616	4,708	4,797	4,886	4,974	5,067	5,155	5,247	5,333	5,426	5,516	5,621	5,722	5,824	5,920	6,033	6,135	6,239	6,33[illegible]

County	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Etowah, AL	12,366	12,540	12,765	12,991	13,218	13,441	13,668	13,894	14,119	14,344	14,571	14,796	15,066	15,339	15,605	15,875	16,146	16,416	16,688
Mobile, AL	26,064	26,405	26,760	27,115	27,470	27,825	28,180	28,515	28,890	29,245	29,600	29,955	30,364	30,773	31,181	31,590	32,000	32,409	32,818
Shelby, AL	82	83	85	86	88	88	91	92	92	94	95	96	99	99	102	104	105	107	108
Bay, FL	4,590	4,694	4,827	4,959	5,093	5,226	5,359	5,490	5,623	5,758	5,891	6,022	6,196	6,370	6,544	6,718	6,890	7,064	7,239
Escambia, FL	1,861	1,893	1,934	1,977	2,018	2,057	2,097	2,137	2,178	2,219	2,259	2,301	2,354	2,406	2,459	2,511	2,564	2,615	2,669
Gulf, FL	8,003	8,166	8,370	8,578	8,784	8,990	9,194	9,400	9,606	9,812	10,017	10,223	10,486	10,749	11,012	11,275	11,536	11,800	12,065
Jackson, MS	3,617	3,683	3,756	3,831	3,905	3,980	4,053	4,127	4,202	4,275	4,349	4,422	4,514	4,607	4,697	4,789	4,880	4,972	5,062
Rest-of-Nation	6,444	6,540	6,678	6,804	6,932	7,062	7,194	7,321	7,453	7,584	7,711	7,840	7,995	8,155	8,315	8,474	8,632	8,789	8,947

[1]All numbers are subtracted from the baseline forecast.

Table I-16 (Cont'd)

IMPACTS ON OUTPUT SECTOR 88, RAILROAD TRANSPORTATION[1]
(Thousands of 1981 $)

County	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Etowah, AL	16,957	17,228	17,498	17,812	18,126	18,440	18,753	19,070	19,384	19,690	20,011	20,327
Mobile, AL	33,228	33,639	34,048	34,508	34,967	35,427	35,886	36,346	36,806	37,265	37,727	38,185
Shelby, AL	111	111	114	115	117	118	121	121	124	126	127	129
Bay, FL	7,412	7,584	7,760	7,976	8,194	8,410	8,626	8,844	9,060	9,278	9,496	9,712
Escambia, FL	2,721	2,775	2,826	2,890	2,953	3,016	3,079	3,141	3,206	3,268	3,331	3,394
Gulf, FL	12,327	12,590	12,853	13,179	13,503	13,829	14,154	14,479	14,805	15,035	15,455	15,780
Jackson, FL	5,155	5,247	5,337	5,448	5,558	5,668	5,777	5,887	5,996	6,107	6,217	6,326
Rest-of-Nation	9,110	9,260	9,427	9,614	9,804	9,994	10,118	10,368	10,555	10,741	10,929	11,120

[1]All numbers are subtracted from the baseline forecast.

Table 1-16 (Cont'd)

IMPACTS ON OUTPUT SECTOR 91, WATER TRANSPORTATION[1]
(Thousands of 1981 $)

County	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2
Etowah, AL	8,255	8,411	8,568	8,720	8,875	9,028	9,181	9,338	9,490	9,649	9,802	9,998	10,190	10,385	10,575	10,773	10,965	11,161	11,
Lowndes, AL	86	86	88	89	89	89	91	92	92	94	94	95	96	96	99	99	101	102	
Mobile, AL	17,346	17,628	17,910	18,188	18,470	18,750	19,031	19,311	19,593	19,874	20,156	20,457	20,761	21,062	21,363	21,665	21,967	22,267	22,
Montgomery, AL	2,050	2,103	2,154	2,205	2,256	2,309	2,360	2,411	2,462	2,515	2,566	2,634	2,703	2,772	2,840	2,909	2,978	3,048	3,
St. Clair, AL	165	171	174	177	181	186	190	194	197	202	206	210	215	219	224	228	232	237	
Shelby, AL	58	60	60	61	63	63	63	64	66	66	66	67	67	69	69	69	70	72	
Talladega, AL	172	181	188	197	205	213	221	229	238	245	253	263	275	285	295	305	316	327	
Bay, FL	2,149	2,225	2,300	2,374	2,449	2,525	2,601	2,675	2,751	2,826	2,900	2,982	3,065	3,147	3,228	3,309	3,391	3,471	3,
Escambia, FL	1,030	1,051	1,071	1,093	1,113	1,134	1,156	1,176	1,197	1,219	1,239	1,265	1,295	1,321	1,349	1,376	1,403	1,430	1,
Gulf, FL	3,640	3,761	3,881	4,003	4,126	4,247	4,370	4,491	4,614	4,734	4,857	4,990	5,123	5,251	5,384	5,519	5,650	5,783	5,
Okaloosa, FL	427	437	449	459	470	481	491	501	514	525	535	540	561	574	586	599	614	625	[illegible]
Jackson, MS	1,395	1,429	1,460	1,492	1,525	1,558	1,590	1,622	1,654	1,686	1,718	1,756	1,791	1,828	1,864	1,901	1,939	1,974	2,
Rest-of-Nation	3,230	3,292	3,352	3,415	3,477	3,540	3,599	3,663	3,723	3,784	3,846	3,917	3,986	4,056	4,128	4,198	4,272	4,342	4,

County	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	20
Etowah, AL	11,548	11,743	11,963	12,180	12,399	12,596	12,817	[illegible]	13,271	13,490	13,708	13,927	14,189	14,450	14,690	14,928	15,239	15,501	15,
Lowndes, AL	104	107	107	110	110	113	113	115	117	118	120	123	124	126	127	130	131	133	1
Mobile, AL	22,872	23,173	23,491	23,811	24,128	24,447	24,765	25,082	25,402	25,721	26,039	26,358	26,723	27,089	27,454	27,818	28,183	28,548	28,9
Montgomery, AL	3,181	3,254	3,315	3,377	3,436	3,499	3,561	3,622	3,683	3,745	3,806	3,903	3,943	4,018	4,093	4,168	4,246	4,320	4,3
St. Clair, AL	245	251	257	262	266	272	278	282	288	292	298	304	310	316	326	333	338	343	3
Shelby, AL	73	73	75	76	77	79	[illegible]	80	82	83	85	86	86	[illegible]	83	92	94	94	
Talladega, AL	330	359	370	380	390	402	[illegible]	422	434	444	454	465	478	[illegible]	504	519	532	545	5
Bay, FL	3,534	3,718	3,835	3,929	4,033	4,139	4,246	4,351	4,456	4,562	4,665	4,772	4,909	5,047	5,184	5,321	5,453	5,596	5,7
Escambia, FL	1,484	1,513	1,544	1,578	1,610	1,642	1,676	1,708	1,740	1,774	1,806	1,838	1,880	1,921	1,965	2,008	2,056	[illegible]	2,1
Gulf, FL	6,035	6,178	6,324	6,470	6,616	6,763	6,909	7,056	7,203	7,348	7,495	7,641	[illegible]	[illegible]	8,371	8,613	8,856	9,097	9,3
Okaloosa, FL	653	666	[illegible]	697	713	731	745	[illegible]	777	791	803	826	845	865	884	[illegible]	923	944	9
Jackson, MS	2,047	2,083	2,126	2,166	2,209	2,252	[illegible]	2,336	2,377	2,418	2,463	2,503	2,555	2,607	2,658	2,710	2,763	[illegible]	2,8
Rest-of-Nation	4,400	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table I-16 (Cont'd)

IMPACTS ON OUTPUT SECTOR 91, WATER TRANSPORTATION[1]
(Thousands of 1981 $)

County	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Etowah, AL	16,028	16,290	16,551	16,859	17,171	17,477	17,784	18,096	18,402	18,712	19,019	19,329
Lowndes, AL	137	140	142	143	146	148	150	153	155	156	159	161
Mobile, AL	29,277	29,642	30,009	30,424	30,839	31,254	31,668	32,084	32,497	32,914	33,326	33,742
Montgomery, AL	4,471	4,547	4,621	4,709	4,797	4,883	4,972	5,058	5,146	5,232	5,320	5,407
St. Clair, AL	358	365	371	380	386	394	401	411	418	427	434	441
Shelby, AL	96	99	99	102	102	105	107	108	110	111	113	114
Talladega, AL	571	586	599	615	633	650	666	684	700	717	733	751
Bay, FL	5,871	6,008	6,147	6,318	6,490	6,663	6,835	6,869	7,178	7,351	7,523	7,694
Escambia, FL	2,177	2,219	2,256	2,313	2,364	2,414	2,465	2,516	2,569	2,620	2,669	2,721
Gulf, FL	9,583	9,827	10,067	10,342	10,615	10,888	11,161	11,434	11,706	11,978	12,251	12,524
Okaloosa, FL	983	1,004	1,023	1,048	1,072	1,099	1,127	1,148	1,173	1,198	1,221	1,246
Jackson, MS	2,918	2,970	3,022	3,083	3,147	3,209	3,270	3,313	3,396	3,457	3,521	3,583
Rest-of-Nation	6,287	6,397	6,502	6,623	6,750	6,879	7,006	7,130	7,254	7,384	7,509	7,636

[1] All numbers are added to the baseline forecast.

Table I-16 (cont'd)

IMPACTS ON OUTPUT SECTOR 90, TRUCKING AND WAREHOUSING[1]
(Thousands of 1986 $)

County	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Etowah, AL	2,081	2,143	2,208	2,268	2,330	2,395	2,458	2,520	2,582	2,645	2,709	2,709	2,868	2,947	3,027	3,109	3,188	3,266	3,337
Lowndes, AL	136	137	137	139	140	142	[illegible]	143	146	146	148	149	150	151	155	156	158	[illegible]	[illegible]
Mobile, AL	4,193	4,210	4,303	4,400	4,575	4,671	4,765	4,861	4,957	5,051	5,147	5,256	5,364	5,470	5,580	5,687	5,795	5,903	6,011
Montgomery, AL	2,767	2,862	2,905	2,975	3,043	3,115	3,182	3,252	3,321	3,391	3,460	3,552	3,645	3,739	3,831	3,923	4,015	4,109	[illegible]
St. Clair, AL	316	324	332	340	348	355	363	371	380	386	394	402	411	419	420	[illegible]	434	[illegible]	[illegible]
Talladega, AL	251	263	275	286	298	310	321	333	345	357	368	384	[illegible]	413	430	444	460	475	[illegible]
Okaloosa, FL	712	730	747	766	784	801	818	836	855	872	890	912	931	956	977	999	1,020	[illegible]	[illegible]
Rest of Nation	76	77	77	79	79	[illegible]	[illegible]	80	82	82	82	82	83	85	86	88	88	89	91

County	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Etowah, AL	3,408	[illegible]	3,636	3,702	3,779	3,838	3,907	3,975	4,043	4,112	4,179	4,247	[illegible]	4,413	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lowndes, AL	168	[illegible]	172	174	177	180	183	183	187	189	192	196	[illegible]	202	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Mobile, AL	6,223	6,333	6,463	6,592	6,725	6,858	[illegible]	7,109	7,238	7,366	7,495	7,626	[illegible]	7,895	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Montgomery, AL	[illegible]	[illegible]	4,537	4,630	[illegible]	4,788	[illegible]	4,966	5,051	5,136	5,219	5,304	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
St. Clair, AL	477	486	496	507	517	528	538	548	559	569	580	590	603	615	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Talladega, AL	514	530	547	562	578	593	609	624	640	655	672	688	[illegible]	727	743	[illegible]	[illegible]	[illegible]	[illegible]
Okaloosa, FL	1,106	1,128	1,155	1,181	[illegible]	1,236	[illegible]	1,290	1,317	1,343	1,370	1,397	[illegible]	1,465	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rest of Nation	93	[illegible]	95	98	[illegible]	[illegible]	[illegible]	103	106	106	108	109	[illegible]	111	113	[illegible]	[illegible]	[illegible]	[illegible]

[1]All values are [illegible] Baseline Forecast.

Table 1-16 (Cont'd)

IMPACTS ON OUTPUT SECTOR 90, TRUCKING AND WAREHOUSING[1]
(Thousands of 1981 $)

County	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Etowah, AL	4,825	4,900	4,980	5,085	5,181	5,277	5,374	5,472	5,568	5,665	5,761	5,857
Lowndes, AL	216	221	224	226	229	232	237	240	244	247	251	254
Mobile, AL	8,715	8,867	9,019	9,206	9,392	9,579	9,766	9,953	10,140	10,325	10,513	10,700
Montgomery, AL	6,027	6,129	6,232	6,350	6,467	6,584	6,703	6,820	6,937	7,056	7,172	7,291
St. Clair, AL	681	694	706	722	736	752	767	783	798	814	828	845
Talladega, AL	831	850	871	896	920	945	970	994	1,018	1,043	1,068	1,093
Okaloosa, FL	1,638	1,670	1,704	1,746	1,787	1,829	1,870	1,911	1,953	1,994	2,035	2,078
Rest-of-Nation	121	121	124	126	127	130	131	133	134	137	139	140

[1]All numbers are subtracted from the baseline forecast.

Table I-17

DETERMINATION OF DAY SECOND FEET LOST TO POWER GENERATION AT LOCKS ON THE COOSA RIVER NAVIGATION PROJECT[1]

Lock	Day Second Feet Lost Through Each Lockage	Percent of Time Turbines at or Below Full Capacity	Day Second Feet Lost to Power Generation
Walter Boudin	56.8	93.5	53.1
Mitchell	28.7	89.5	[illegible]
Lay	40.1	[illegible]	[illegible]
Logan Martin	33.0	91.0	[illegible]
H. Neely Henry	20.5	[illegible]	19.0

Table I-18

ANTICIPATED DAILY LOCKAGES AT VARIOUS LOCKS ON THE COOSA RIVER NAVIGATION PROJECT[1]

Year	Walter Bouldin	Mitchell	Lay	Logan Martin	H. Neely Henry
1990	5.7	5.7	5.7	3.6	[illegible]
2000	6.8	6.8	6.8	4.3	4.0
2010	8.1	8.1	8.1	5.0	4.6
2020	9.6	9.6	9.6	5.7	5.3
2030	11.4	11.4	11.4	6.7	6.1
2039	13.3	13.3	13.3	[illegible]	7.0

[1]Source: Mobile District, Corps of Engineers, *General Design Memorandum*, December 1981.

The formula for annual power generation loss (in dollars) is

(1) day second feet lost to power generation/4.55

<u>multiplied by</u>

(2) lockages per day

<u>multiplied by</u>

(3) days in year (assumed to be 365)

<u>multiplied by</u>

(4) value of electricity per megawatt-hour.

The result is the annual reduction in gross revenues attributable to navigation activity at each lock.

As discussed above, the GDM shows lockages per day at each dam every ten years from 1990 to 2030, and for 2039. Lockages for intervening years were derived by linear interpolation. The average value per megawatt-hour was taken from <u>Statistics of Privately-Owned Utilities in the United States</u> (1980), a publication of DOE/EIA. The average value represents the spread between the cost of wholesale power ("sales for resale") purchased from other utilities to replace the lost power production at the dams, and the average price that Alabama Power Company charges its retail customers. The sales price to retail customers in 1980 averaged $43.70 per megawatt-hour, and the cost of power purchased for resale averaged $29.70 per MWH; therefore, the spread was $14 per MWH in 1980 dollars, or $15.50 in October 1981 dollars.

This value is similar to the $14 per MWH estimate in the October 1981 GDM. The Corps of Engineers estimate is based on data provided by the Federal Energy Regulatory Commission (FERC) and by Alabama Power Company.

The average gross revenue [illegible] distributed to counties using the [illegible] construction impacts. The revenue [illegible] totalled and subtracted from the [illegible] 70: Electric Utilities (Table [illegible]).

This study assumed that Alabama P[illegible] power for resale to offset the power [illegible] navigation activity at each [illegible] will be purchased from the [illegible] of this wholesale power will [illegible] $[illegible] per MWH in [illegible], or $33 per MWH in October 1981 dollars. Th[illegible] Alabama Power Company's cost [illegible] in 19[illegible], as reported in the DOE/EIA source cited [illegible] utilities in the "rest-of-nation" [illegible] to sales for resale are added to the baseline output [illegible]

I.8 Intermediate [illegible]

I.8.1 Conversions of October [illegible] 19[illegible] Dollars

Impacts for the MRMI model [illegible] in 19[illegible] dollars. As data in the Corps' General [illegible] were [illegible] October 1981 dollars, they [illegible] county or rest-of-nation total[illegible]. The gross national product [illegible]

Table I-19

IMPACTS ON OUTPUT SECTOR 70,

ELECTRIC UTILITIES[1]

(Thousands of 1981$)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Montgomery Cty.	430	438	444	451	457	466	472	479	487	494	500	508	517	526	535	545	554	563	573
Elmore County	95	96	99	101	102	104	105	107	108	110	111	113	115	117	118	120	121	123	124
Autauga County	[illegible]	67	70	72	73	75	76	77	79	80	82	85	86	88	89	91	92	94	95
Coosa County	[illegible]	25	25	26	26	26	28	28	28	28	29	29	29	31	31	31	32	32	32
Chilton County	[illegible]	67	70	72	73	75	76	77	79	80	82	85	86	88	89	91	92	94	95
Tallapoosa Cty.	[illegible]	[illegible]	164	167	169	171	175	178	181	184	187	191	194	197	200	203	207	210	213
Shelby County	143	146	149	152	155	158	162	165	168	171	175	178	181	184	187	191	194	197	200
Calhoun County	267	272	276	282	286	291	297	301	305	311	316	321	329	335	342	348	352	359	365
St. Clair Cty.	86	88	89	91	92	94	95	96	99	101	102	104	105	107	108	110	111	113	115
[illegible] County	[illegible]	229	235	240	244	248	254	259	263	269	273	278	283	288	292	298	302	307	313
Rest of Nation	3,321	3,384	3,448	3,511	3,574	3,638	3,701	3,765	3,828	3,891	3,955	4,027	4,098	4,170	4,242	4,313	4,385	4,456	4,528

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Montgomery Cty.	580	590	602	614	624	636	647	659	669	682	694	704	716	728	741	752	766	779	789
Elmore County	126	127	130	131	133	134	136	137	139	140	142	146	149	152	155	158	162	165	168
Autauga County	[illegible]	99	101	102	104	105	107	108	110	111	113	115	117	118	120	121	123	124	126
Coosa County	33	34	35	35	35	37	37	37	39	39	39	41	41	42	42	44	44	44	45
Chilton County	[illegible]	99	101	102	104	105	107	108	110	111	113	115	117	118	120	121	123	124	126
Tallapoosa Cty.	[illegible]	221	224	228	231	235	238	241	243	247	251	254	259	263	269	273	278	283	288
Shelby County	203	207	210	213	216	219	224	226	229	232	237	241	245	251	256	260	266	270	275
Calhoun County	[illegible]	378	381	392	[illegible]	408	416	[illegible]	[illegible]	440	[illegible]	451	463	469	478	485	494	501	508

Table I-19 (Cont'd)

IMPACTS ON OUTPUT SECTOR 70,

ELECTRIC UTILITIES[1]

(Thousands of 1981$)

	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Montgomery Cty.	802	815	827	843	859	875	890	906	922	937	951	966
Elmore County	171	175	178	181	184	187	191	194	197	200	203	207
Autauga County	127	130	131	133	134	136	137	139	140	142	145	146
Coosa County	45	45	47	47	48	48	50	51	51	54	54	56
Chilton County	127	130	131	133	134	136	137	139	140	142	145	146
Talladega Cty.	292	298	302	307	313	317	321	327	332	336	342	346
Shelby County	281	285	282	294	300	304	308	314	319	323	329	333
Calhoun County	516	525	532	542	552	561	571	580	590	601	611	622
St. Clair Cty.	161	164	167	169	172	177	[illegible]	183	186	190	193	196
Etowah County	425	432	438	447	454	463	470	479	487	495	504	511
Rest of Nation[2]	6,278	6,378	6,476	6,591	6,706	6,820	[illegible]	7,050	7,165	7,281	7,395	7,510

[1] County numbers are subtracted from the baseline forecast.

[2] Rest of nation numbers are added to the baseline forecast.

adjusting the revenue estimates for output sector 70: Electric Utilities. For

- o Equipment Purchasing Sector 66: Buses, Waterways, and Pipelines
- o Public Construction Sector 24: Water Systems
- o Federal Government Expenditures Sector 11: Water Transportation

the implicit price deflator for federal government purchases of goods and services was used.

For neither deflator was the October 1981 value available, although third quarter 1981 was available. Therefore, an October 1981 deflator was estimated by linear extrapolation of the second and third quarter 1981 values. The ratio of the 1976 value to the October 1981 value was then applied to the October 1981 dollar estimates to derive 1976 dollar estimates (Table I-20).

I.8.2 Constants for Power Loss Calculations

The equation for calculating reductions in electric power revenue because of lockages can be reduced to a constant which is multiplied by the average value per MWH of the power not generated. The constants for all 5 dams from 1990 to 2039 are shown in Table I-21; and are shown for each individual lock at ten-year intervals in Table I-22.

Table I-20

PRICE INDEXES[1]

	1976	Third Quarter 1981	October 1981[2]
I. Federal Government Purchases of Goods and Services (Implicit price deflator)	134.8	206.0	207.4
II. Gross National Product (Implicit Price Deflator)	132.1	195.4	196.9

[1] U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business and Business Statistics 1977.

[2] October 1981 estimates were derived by linear extrapolation of the growth in the index between the second and third quarters of 1981.

Table I-21

POWER LOSS EQUATION CONSTANTS, TOTAL OF ALL LOCKS, 1990-2039

Year	Power Loss Constant	Year	Power Loss Constant	Year	Power Loss Constant
1990	102658	2010	144401	2030	200204
1991	104618	2011	146914	2031	203754
1992	106577	2012	149428	2032	207304
1993	108537	2013	151941	2033	210854
1994	110496	2014	154455	2034	214404
1995	112456	2015	156968	2035	217954
1996	114416	2016	159481	2036	221503
1997	116375	2017	161995	2037	225053
1998	118335	2018	164508	2038	228603
1999	120294	2019	167022	2039	232153
2000	122254	2020	169535		
2001	124469	2021	172602		
2002	126683	2022	175669		
2003	128898	2023	178736		
2004	131113	2024	181803		
2005	133328	2025	184870		
2006	135542	2026	187936		
2007	137757	2027	191003		
2008	139972	2028	194070		
2009	142186	2029	197127		

Table I-22

POWER LOSS EQUATION CONSTANTS FOR EACH LOCK, 1990-2039

YEAR	LOCK				
	Bouldin	Mitchell	Lay	Logan Martin	Neely Henry
1990	24280	24280	24280	15335	14483
2000	28966	28966	28966	18317	17039
2010	34503	34503	34503	21298	19594
2020	40893	40893	40893	24280	22576
2030	48560	48560	48560	28540	25984
2039	56654	56654	56654	32373	29818

APPENDIX II

GLOSSARY OF ECONOMIC VARIABLES IN MRMI

[illegible]

Glossary of [illegible]

Introduction

The following glossary defines [illegible] of the terms and data categories relevant to the MRMI model. In some cases simple definitions are presented. In other cases these definitions are supplemented with information on how historical regional data series have been developed. No information in this glossary relates to the form or format of forecast estimating equations, however.

<u>Agricultural Land Value</u>

The value of agricultural land per acre is from the <u>County City Databook</u> based on a universal sample of all farmers published by the Census of Agriculture. It includes the current market value of land and buildings owned, rented or leased from others, and rented or leased to others. The market value was the respondent's estimate under current market conditions. When a value was not reported, the average value of farms in the area having similar characteristics was used. When farm acreage crossed county boundaries, the value of agricultural land was counted towards the county in which the farm headquarters was located.

<u>BEA Economic Areas</u>

These are geographic areas designated by the Bureau of Economic Analysis of the U.S. Department of Commerce. The BEA economic areas are economically specialized regions engaged in a pattern of mutual trade that is based on the comparative advantage of producing certain commodities. At the same time, each area is relatively self-sufficient in the production of most of its services. Each area consists of a Standard Metropolitan Statistical Area (SMSA), or a central county, and the surrounding counties that are economically related to the center, thus combining the place-of-work and place-of-residence of its labor force.

<u>Civilian Labor Force</u>

The civilian labor force equals the sum of "Total Civilian Employment" and "Civilian Unemployment."

<u>Commuter Income</u>

Commuter income is obtained on a regional level from BEA and represents the earnings of workers who are employed outside their county of residence. This residence adjustment is added to earnings by place of work to obtain earnings by place of residence for each county.

Commuters

Information on commuters is derived from the 1970 Census of Population. In that Census information on the number of workers commuting out of their county of residence and the county of their work destination was collected. Adjustments made to this information are based on BEA commuter income information by county.

Competitive Imports

Competitive imports are those imports used as intermediate or final goods which are similar to or compete directly with goods produced in the United States. An example of a competitive import is steel, which can be purchased from foreign or domestic producers.

Construction Expenditures

Construction expenditures are reported for 26 categories. These represent actual expenditures on construction by individuals, businesses, public agencies and other organizations. The 26 categories represent simple combinations of the 30 categories for national construction value data reported by the Bureau of the Census. Census figures are based on the value of construction permits. Permit data, by region, is used to share out the national control totals for construction expenditures. This ensures that the sum of regional construction expenditures equals national construction expenditures. The first construction expenditure category -- single family and mobile homes -- includes only single family units. According to Census sources, this definition includes townhouses but excludes condominiums which are not designed specifically as townhouses (e.g., large apartment-type buildings). The Census Bureau defines single family homes as those homes where the only adjoining walls to another dwelling run from basement (or floor, if there is no basement) to ceiling, with no vertical adjoinings (i.e., no separate dwelling units situated above or below). Construction costs of single-family houses are estimated using data from the Census Bureau's survey of housing authorized by building permits and of housing units started. Average permit values are increased to account for undervaluation on the permit and architectural and engineering fees. Adjustments to permit values are also made for other categories to ensure that construction values for all categories are reported on a comparable basis. Also, sales price of mobile homes (from the manufacturer) are added to single family construction expenditures (and national construction expenditures) to determine total regional value of construction expenditures for single family homes plus mobile homes.

Defens

Deflati

Earnings

Employ

Equipme

year are then calculated using the national ratio ... equipment purchases to output for each sector. Equipment purchases as reported in the MRMI model are consistent with equipment purchases as reported in the National Income accounts.

Federal Government Enterprises

Typically these are activities of the federal government which cover their operating costs with operating revenues from sales to the public. However, in the context of the MRMI model, certain activities included here are allocated to several sectors within the model: Post Office, utilities, and transportation. The numbers reported for this sector include such institutions as: Federal Savings and Loan Insurance Corporation, Federal Home Loan Bank, Federal Deposit Insurance Corporation, etc..

Federal Government Expenditures

These are listed by function and are based on historical data from the U.S. Office of Management and Budget, Federal Outlays by Geographic Area. The expenditure totals are for purchases of goods and services and do not include government payrolls or construction expenditures. County estimates for NASA and general government expenditures were made using the OMB data and then converted to county demand by producing sectors using the national coefficients.

Federal Government Purchases

Includes government expenditures plus employee compensation, but excludes construction expenditures.

Final Demand

Final demand is a concept which is nearly equivalent to gross national product. It includes personal consumption expenditures, investment expenditures (for equipment and construction), government expenditures (broadly categorized as federal defense expenditures, federal non-defense expenditures and state and local government expenditures) and gross foreign exports.

Foreign Exports and Imports

Foreign exports and imports are measured by port of shipment or entry from data obtained from several sources. For shipments by water this information ... obtained from the Army Corps of Engineers, Waterborne Commerce of the U.S. and from Bureau of Census information. Overland exports to Canada and Mexico ... allocated to customs districts using data from ... of U.S. Export and Import Trade. Exports and imports ... air for all manufacturing goods were used to allo...

international commodity movements by air (exports and imports were allocated to major international airports noted in Highlights of U.S. Export and Import Trade).

Input/Output Coefficient Matrix

Interindustry commodity flows can be represented in a matrix format. The coefficients of this matrix express the ratio of the demand for inputs in dollars per dollar of total output for that sector. The input/output coefficients thus express in economic terms the technological interdependencies that tie each industry to its suppliers and its customers.

Intermediate Demand

Intermediate demand for any industry sector consists of the output of that sector which is used by that sector or any other producing sector as an input for the production of final demand goods. Intermediate demand excludes, however, all investment expenditures, since investment in machinery or construction is classified as part of final demand.

Maintenance Construction

This includes construction or repair undertaken to restore a structure, or part thereof. Output for this sector includes services to industry and government sectors and not services to private consumers. Improvements to any structure are included in the new construction sector. Economic output for the maintenance construction sector is stated in terms of value added.

Multijob Holders

Multijob holders are defined as persons who hold more than one job. To estimate this by county, the national ratio of multijob holders to total jobs is multiplied by the number of jobs for a county. The national ratio is estimated using information from INFORUM.

Net Commuters

Net commuters are equal to the difference between "in-commuters" and "out-commuters" to any geographic area. If more people commute into an area than out of the area, the sign on the net commuters figure will be positive.

Noncompetitive Imports

Goods that are not produced domestically are classified as non-competitive goods. Examples of non-competitive goods are rubber, mahogany and certain strategic metals.

Non-White Population

The definition of non-white population is based on the definition used for the 1970 Census of Population. In that Census respondents were asked to self-classify their race. Non-white categories included on the form included "Negro," "Indian," "Other Native American," and "Asian."

Output

Four types of output are specified in the MRMI model. For the agricultural, mining and manufacturing sectors, output is measured as gross value of shipments. Regional data on shipments is controlled to a national value of production provided by INFORUM for each sector, which includes inventories. For the transportation and trade (wholesale and retail) sectors, output is measured in terms of "gross trade margins." These margins are equal to the difference between the sales price and the cost of the goods sold or shipped. For the utilities, communications, and services sectors output is measured in terms of gross revenues. Finally, in the construction sectors output is measured in terms of value added by the sector.

Payrolls

(Sometimes referred to as "Earnings.") Payrolls are wage and salary disbursements and consist of monetary remuneration of employees, including corporate officers; commissions, tips and bonuses; and receipts in kind that represent income to recipients. Payrolls also include proprietors' income plus fringe benefits paid to labor. All of the historical data is derived from BEA sources, although other sources are used to allocate the BEA aggregation to detailed sectors. . These include:

- for railroads, decennial Census of Population data is available by county. County numbers are adjusted each year to state numbers from BEA..
- for private households, employment and hours worked data collected by the Census Bureau for the decennial census is used to allocate state data from BEA in non-census years.
- for nonprofit membership organizations and educational services, tabulations prepared by professional and trade associations.

Payrolls are reported by place of work.

Personal Consumption Expenditures

Personal consumption expenditures are expenditures by persons reported for 104 MRMI sectors. For several sectors personal consumption expenditures are reported in terms of industry markup margins. These sectors are transportation services, wholesale trade and retail [illegible] for [illegible] PCE for these [illegible] purchased by [illegible] and [illegible] for the [illegible].

[illegible] ce [illegible] and the wholesa[illegible], the [illegible] to [illegible]

Person[illegible]

[illegible] BEA [illegible] of [illegible] particip[illegible] from [illegible] interest, [illegible] and [illegible]

Populat[illegible]

[illegible] of [illegible] al, [illegible] and members of [illegible] are [illegible] ives [illegible]

Private [illegible]

[illegible]

Private Household Employment

This sector includes private households which employ workers who serve on or about the premises in occupations usually considered as domestic service. Household employees include individuals, such as cooks, laundresses, maids, sitters, butlers, personal secretaries, and managers of personal affairs as well as outside workers such as gardeners, caretakers and other maintenance establishments. Private household employment is defined as SIC sector 88 and does not include households of farming establishments or groups providing in-home entertainment or day-care services. The Census of Population is the source for this information for census years; state data are available in non-census years from BEA.

Private Investment

Private investment includes equipment purchases plus private construction expenditures.

Property Income

This item is reported from the Bureau of Economic Analysis, Regional Economic Measurement Division. It includes monetary and imputed interest income, rental income from rental of real property as well as imputed net income of owner occupants of nonfarm dwellings, royalties received from patents and copyrights as well as dividends.

Shadow Prices

The MRMI model uses a linear programming algorithm to estimate transportation costs for net transportation flows for each commodity into and out of a region. Marginal transportation costs are represented by the shadow prices which are derived from the solution of this algorithm. The shadow prices represent solutions of the dual variables of the transportation cost minimization problem.

Social Insurance Payments

These are defined as payments made by individuals into the Social Security system.

State and Local Government Enterprises

Agencies of state and local governments which cover their operating costs with operating revenues from sales to the public. Subtracted from this in the MRMI model are sectors included elsewhere: transportation, water utilities, and electric utilities. The numbers reported for this sector include such functions as: Housing and Urban Renewal projects, public housing authorities, etc.

State and Local Government Expenditures

The data for this series are derived from the Bureau of the Census, 1977 Census of Governments. The expenditure totals are for purchases of goods and services and do not include government payrolls or construction expenditures.

State and Local Government Purchases

These include the above expenditures plus employee compensation but exclude construction expenditures.

Sum of Employment by Place of Residence

For each geographic area the "sum of employment by place of residence" represents the sum of employment by each sector (reported by place of work -- see "Total Sectoral Employment") adjusted both for net commuters to the area and multijob holders.

Total Civilian Employment

Total civilian employment equals total persons employed, excluding military personnel, by place of residence. It is derived by adding employment for all sectors (excluding Section 108 - Armed Forces) plus total net commuters minus multijob holders.

Total Demand

Total demand is the sum of intermediate demand and final demand by users in each area plus the amount of foreign exports exiting the nation through ports (air, land or water) in the area.

Total Earnings by Place of Work

This represents the simple sum of payrolls for all industrial sectors in an area. Payrolls are reported by place of work.

Total Sectoral Employment

This includes [illegible] multijob holders and is reported by place of work.

Total Supply

Total supply is the total amount of production in each area plus the amount of foreign imports entering the nation through ports in the area.

Transfer Payments

Money [illegible] government and business to individuals [illegible]. The principal components are [illegible] payments and welfare payments.

Unemployment

Historical unemployment data is derived from information collected for the Bureau of Labor Statistics, U.S. Department of Labor by the state employment security agencies (ESAs). The estimate of unemployment is an aggregate of the estimates for each of three building block categories: (1) persons who were previously employed in industries covered by State unemployment insurance (UI) laws; (2) those previously employed in industries not covered by these laws; and (3) those who were either entering the labor force for the first time or reentering after a period of separation. This is referred to as the UI-based estimate. Historical data for state unemployment are calculated monthly by state ESAs and are adjusted at least annually (depending on the state) to coincide with unemployment estimates developed through the Current Population Survey. Estimates of sub-state unemployment are developed by ESAs by sharing out state unemployment to sub-state areas based on the proportion of unemployment in that area found in the most recent decennial Census of Population.

Value Added

Value added by producing industries in an area includes earnings, corporate profits, taxes, rents and interest paid by industry and depreciation.

White Population

This definition is derived from the 1970 Census of Population and includes all but "non-whites." (See also "Non-White Population.")

APPENDIX III

COUNTIES IN BEA ECONOMIC AREA
ORIGIN-DESTINATION PAIRS

APPENDIX III

COUNTIES IN BEA ECONOMIC AREA ORIGIN-DESTINATION PAIRS

BEA Code	Economic Area Name	FIPS SMSA Code	FIPS County Code	SMSA Name	County Name
016	Pittsburgh, PA				
		0280		Altoona, PA	
			42013		PA Blair
		3680		Johnstown, PA	
			42021		PA Cambria
			42111		PA Somerset
		6280		Pittsburgh, PA	
			42003		PA Allegheny
			42007		PA Beaver
			42125		PA Washington
			42129		PA Westmorelan
		NONSMSA COUNTIES			
			24001		MD Allegany
			24023		MD Garrett
			42005		PA Armstrong
			42009		PA Bedford
			42019		PA Butler
			42051		PA Fayette
			42059		PA Greene
			42063		PA Indiana
			54057		WV Mineral
036	Atlanta, GA				
		0520		Atlanta, GA	
			13035		GA Butts
			13057		GA Cherokee
			13063		GA Clayton
			13067		GA Cobb
			13089		GA Dekalb
			13097		GA Douglas
			13113		GA Fayette
			13117		GA Forsyth
			13121		GA Fulton
			13135		GA Gwinett
			13151		GA Henry
			13217		GA Newton
			13223		GA Paulding
			13247		GA Rockdale
			13297		GA Walton
		NONSMSA COUNTIES			
			13011		GA Banks
			13013		GA Barrow
			13015		GA Bartow
			13045		GA Carroll
			13059		GA Clarke
			13077		GA Coweta
			13085		GA Dawson
			13105		GA Elbert
			13111		GA Fannin

APPENDIX III (Continued)

COUNTIES IN BEA ECONOMIC AREA ORIGIN-DESTINATION PAIRS

BEA Code	Economic Area Name	FIPS SMSA Code	FIPS County Code	SMSA Name	County Name
			13115		GA Floyd
			13119		GA Franklin
			13123		GA Gilmer
			13129		GA Gordon
			13133		GA Greene
			13137		GA Habersham
			13139		GA Hall
			13143		GA Haralson
			13147		GA Hart
			13149		GA Heard
			13157		GA Jackson
			13159		GA Jasper
			13171		GA Lamar
			13187		GA Lumpkin
			13195		GA Madison
			13211		GA Morgan
			13219		GA Oconee
			13221		GA Oglethorpe
			13227		GA Pickens
			13231		GA Pike
			13233		GA Polk
			13241		GA Rabun
			13255		GA Spalding
			13257		GA Stephens
			13281		GA Towns
			13291		GA Union
			13293		GA Upson
			13311		GA White
046	Pensacola-Panama City, FL				
		6015		Panama City, FL	
			12005		FL Bay
		6080		Pensacola, FL	
			12033		FL Escambia
			12113		FL Santa Rosa
		NONSMSA COUNTIES			
			12045		FL Gulf
			12059		FL Holmes
			12091		FL Okaloosa
			12131		FL Walton
			12133		FL Washington
047	Mobile, AL				
		5160		Mobile, AL	
			01003		AL Baldwin
			01097		AL Mobile
		6025		Pascagoula-Moss Point, MS	
			28059		MS Jackson

APPENDIX III (Continued)

COUNTIES IN BEA ECONOMIC AREA ORIGIN-DESTINATION PAIRS

BEA Code	Economic Area Name	FIPS SMSA Code	FIPS County Code	SMSA Name	County Name
		NONSMSA COUNTIES			
			01023		AL Choctaw
			01025		AL Clarke
			01035		AL Conecuh
			01053		AL Escambia
			01091		AL Marengo
			01099		AL Monroe
			01129		AL Washington
			01131		AL Wilcox
			28039		MS George
			28041		MS Greene
048	Montgomery, AL				
		5240		Montgomery, AL	
			01001		AL Autauga
			01051		AL Elmore
			01101		AL Montgomery
			NONSMSA COUNTIES		
			01005		AL Barbour
			01011		AL Bullock
			01013		AL Butler
			01031		AL Coffee
			01037		AL Coosa
			01039		AL Covington
			01041		AL Crenshaw
			01045		AL Dale
			01047		AL Dallas
			01061		AL Geneva
			01067		AL Henry
			01069		AL Houston
			01085		AL Lowndes
			01087		AL Macon
			01105		AL Perry
			01109		AL Pike
			01123		AL Tallapossa
049	Birmingham, AL				
		0450		Anniston, AL	
			01015		AL Calhoun
		1000		Birmingham, AL	
			01073		AL Jefferson
			01115		AL St. Clair
			01117		AL Shelby
			01127		AL Walker
		2880		Gadsen, AL	
			01055		AL Etowah
		8600		Tuscaloosa, AL	
			01125		AL Tuscaloosa

APPENDIX III (Continued)

COUNTIES IN BEA ECONOMIC AREA ORIGIN-DESTINATION PAIRS

BEA Code	Economic Area Name	FIPS SMSA Code	FIPS County Code	SMSA Name	County Name
			NONSMSA COUNTIES		
			01007		AL Bibb
			01009		AL Blount
			01019		AL Cherokee
			01021		AL Chilton
			01027		AL Clay
			01029		AL Cleburne
			01043		AL Cullman
			01057		AL Fayette
			01063		AL Greene
			01065		AL Hale
			01075		AL Lamar
			01093		AL Marion
			01107		AL Pickens
			01111		AL Randolph
			01119		AL Sumter
			01121		AL Talladega
			01133		AL Winston
051	Chattanooga, TN				
		1560		Chattanooga, TN-GA	
			13047		GA Catoosa
			13083		GA Dade
			13295		GA Walker
			47065		TN Hamilton
			47115		TN Marion
			47153		TN Sequatchie
			NONSMSA COUNTIES		
			01049		AL De Kalb
			01071		AL Jackson
			13055		GA Chattooga
			13213		GA Murray
			13313		GA Whitfield
			47007		TN Bledsoe
			47011		TN Bradley
			47061		TN Grundy
			47107		TN Mc Minn
			47121		TN Meigs
			47123		TN Monroe
			47139		TN Polk
			47143		TN Rhea
083	Chicago, IL				
		1600		Chicago, IL	
			17031		IL Cook
			17043		IL Du Page
			17089		IL Kane
			17097		IL McHenry
			17197		IL Will

APPENDIX III (Continued)

COUNTIES IN BEA ECONOMIC AREA ORIGIN-DESTINATION PAIRS

BEA Code	Economic Area Name	FIPS SMSA Code	FIPS County Code	SMSA Name	County Name
		2960		Gary-Hammond-East Chicago, IN	
			18089		IN Lake
			18127		IN Porter
		3740		Kankakee, IL	
			17091		IL Kankakee
		3800		Kenosha, WI	
			55059		WI Kenosha
			NONSMSA COUNTIES		
			17011		IL Bureau
			17037		IL De Kalb
			17063		IL Grundy
			17075		IL Iroquois
			17093		IL Kendall
			17099		IL La Salle
			17105		IL Livingston
			17155		IL Putnam
			18073		IN Jasper
			18091		IN LaPorte
			18111		IN Newton
			18131		IN Pulaski
			18149		IN Starke
089	Milwaukee, WI				
		5080		Milwaukee, WI	
			55079		WI Milwaukee
			55089		WI Ozaukee
			55131		WI Washington
			55133		WI Waukesha
		6600		Racine, WI	
			55101		WI Racine
			NONSMSA COUNTIES		
			55027		WI Dodge
			55055		WI Jefferson
			55117		WI Sheboygan
			55127		WI Walworth
105	Kansas City, MO				
		3760		Kansas City, MO-KS	
			20091		KS Johnson
			20209		KS Wyandotte
			29037		MO Cass
			29047		MO Clay
			29095		MO Jackson
			29165		MO Platte
			29177		MO Ray
		4150		Lawrence, KS	
			20045		KS Douglas
		7000		St. Joseph, MO	

COUNTIES IN BEA ECONOMIC AREA ORIGIN-DESTINATION PAIRS

BEA Code	Economic Area Name	FIPS SMSA Code	FIPS County Code	SMSA Name	County Name
			29003		MO Andrew
			29021		MO Buchanan
			NONSMSA COUNTIES		
			20003		KS Anderson
			20005		KS Atchison
			20013		KS Brown
			20043		KS Doniphan
			20059		KS Franklin
			20103		KS Leavenworth
			20107		KS Linn
			20121		KS Miami
			29005		MO Atchison
			29013		MO Bates
			29015		MO Benton
			29025		MO Caldwell
			29033		MO Carroll
			29049		MO Clinton
			29061		MO Daviess
			29063		MO Dekalb
			29075		MO Gentry
			29079		MO Grundy
			29081		MO Harrison
			29083		MO Henry
			29087		MO Holt
			29101		MO Johnson
			29107		MO Lafayette
			29117		MO Livingston
			29129		MO Mer[illegible]
			29147		MO Nodaway
			29159		MO Pettis
			29195		MO Saline
			29227		MO Worth
107	St. Louis, MO				
		7040		St. Louis, MO-IL	
			17027		IL Clinton
			17119		IL Madison
			17133		IL Monroe
			17163		IL St. Clair
			29071		MO Franklin
			29099		MO Jefferson
			29183		MO St. Charles
			29189		MO St. Louis
			29510		MO St. Louis IND. City
			NONSMSA COUNTIES		
			17003		IL Alexander
			17005		IL Bond

APPENDIX III (Continued)

COUNTIES IN BEA ECONOMIC AREA ORIGIN-DESTINATION PAIRS

BEA Code	Economic Area Name	FIPS SMSA Code	FIPS County Code	SMSA Name	County Name
			17013		IL Calhoun
			17025		IL Clay
			17049		IL Effingham
			17051		IL Fayette
			17055		IL Franklin
			17061		IL Greene
			17077		IL Jackson
			17079		IL Jasper
			17081		IL Jefferson
			17083		IL Jersey
			17087		IL Johnson
			17117		IL Macoupin
			17121		IL Marion
			17135		IL Montgomery
			17145		IL Perry
			17153		IL Pulaski
			17157		IL Randolph
			17159		IL Richland
			17181		IL Union
			17189		IL Washington
			17191		IL Wayne
			17199		IL Williamson
			29017		MO Bollinger
			29023		MO Butler
			29031		MO Cape Girardeau
			29035		MO Carter
			29055		MO Crawford
			29065		MO Dent
			29073		MO Gasconade
			29093		MO Iron
			29113		MO Lincoln
			29123		MO Madison
			29125		MO Maries
			29133		MO Mississippi
			29139		MO Montgomery
			29157		MO Perry
			29161		MO Phelps
			29179		MO Reynolds
			29181		MO Ripley
			29187		MO St. Francois
			29193		MO Ste. Genevieve
			29201		MO Scott
			29207		MO Stoddard
			29219		MO Warren
			29221		MO Washington
			29223		MO Wayne

APPENDIX III (Continued)

COUNTIES IN BEA ECONOMIC AREA ORIGIN-DESTINATION PAIRS

BEA Code	Economic Area Name	FIPS SMSA Code	FIPS County Code	SMSA Name	County Name
120	New Orleans, LA				
		0920		Biloxi-Gulfport, MS	
			28045		MS Hancock
			28047		MS Harrison
			28131		MS Stone
		5560		New Orleans, LA	
			22051		LA Jefferson
			22071		LA Orleans
			22087		LA St. Bernard
			22103		LA St. Tammany
			NONSMSA COUNTIES		
			22007		LA Assumption
			22057		LA La Fourche
			22075		LA Plaquemines
			22089		LA St. Charles
			22093		LA St. James
			22095		LA St. John The Baptist
			22105		LA Tangipahoa
			22109		LA Terrebonne
			22117		LA Washington
			28035		MS Forrest
			28073		MS Lamar
			28091		MS Marion
			28109		MS Pearl River
			28111		MS Perry
			28113		MS Pike
			28147		MS Walthall
121	Beaumont-Port Arthur, TX				
		0840		Beaumont-Port Arthur -Orange, TX	
			48199		TX Hardin
			48245		TX Jefferson
			48361		TX Orange
			NONSMSA COUNTIES		
			48241		TX Jasper
			48351		TX Newton
			48403		TX Sabine
			49457		TX Tyler
122	Houston, TX				
		1260		Bryan-College Station, TX	
			48041		TX Brazos
		2920		Galveston-Texas City, TX	
			48167		TX Galveston
		3360		Houston, TX	
			48039		TX Brazoria
			48157		TX Fort Bend
			48201		TX Harris
			48291		TX Liberty
			48339		TX Montgomery

COUNTIES IN BEA ECONOMIC AREA ORIGIN-DESTINATION PAIRS

BEA Code	Economic Area Name	FIPS SMSA Code	FIPS County Code	SMSA Name	County Name
			48473		TX Waller
			NONSMSA COUNTIES		
			48015		TX Austin
			48051		TX Burleson
			48057		TX Calhoun
			48071		TX Chambers
			48089		TX Colorado
			48123		TX De Witt
			48149		TX Fayette
			48175		TX Goliad
			48185		TX Grimes
			48239		TX Jackson
			48285		TX Lavaca
			48289		TX Leon
			48313		TX Madison
			48321		TX Matagorda
			48373		TX Polk
			48395		TX Robertson
			48407		TX San Jacinto
			48455		TX Trinity
			48469		TX Victoria
			48471		TX Walker
			48477		TX Washington
			48481		TX Wharton
131	Brownsville-McAllen-Harlingen, TX				
		1240		Brownsville-Harlingen -San Benito, TX	
			48061		TX Cameron
		4880		McAllen-Pharr-Edinburg, TX	
			48215		TX Hidalgo
			NONSMSA COUNTIES		
			48427		TX Starr
			48489		TX Willacy

APPENDIX IV

TRAINING COURSE OUTLINE

AD-A150 318 REGIONAL DEVELOPMENT IMPACTS MULTI-REGIONAL - 3/3
MULTI-INDUSTRY MODEL (MRMI)..(U) OKLAHOMA UNIV NORMAN
CENTER FOR ECONOMIC AND BUSINESS RESEARC..
UNCLASSIFIED P D HALL ET AL. SEP 82 IWR-84-UM-2 F/G 13/2 NL

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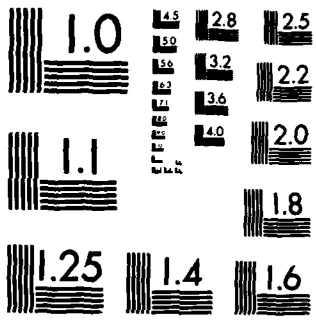
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1.25
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APPENDIX IV

TRAINING COURSE OUTLINE

1.0 INTRODUCTION

This Training Course Manual is an outline of activities to be undertaken in an 8-hour training session for U.S. Army Corps of Engineers personnel involved in regional water development impact evaluation. The course is designed to fulfill the following objectives:

- to familiarize Corps personnel with the Multiregional Multi-Industry (MRMI) econometric forecasting model and its capabilities for estimating regional economic development impacts;
- to detail procedures for configuring the model for impacts evaluation and for developing appropriate macroeconomic and direct impacts data to generate consistent economic forecasts;
- to describe the sequence of tasks required to forecast regional economic activity; and
- to assist project planners in interpreting model output and analyzing regional development impacts.

The training course is based upon a User Manual developed for the Corps, The Multiregional Multi-Industry (MRMI) Model of the U.S. Economy: User Manual for Evaluating Regional Development Impacts of Water Resource Projects. This manual is the major reference source for the training course and subsequent applications of MRMI to Corps water resource projects.

The training course has been divided into two sessions covering different aspects of regional impact evaluation using MRMI. The first session introduces the multiregional model, both its theoretical structure and its application to impact evaluation studies. Emphasis is placed upon data development activities, including the definition of impact areas, estimation of macroeconomic and direct impacts data and the allocation of direct impacts to the regional economies that make up the impact areas. The second session concerns the interpretation of model outputs and issues in the analysis of regional development impacts. Included in this session is an overview of data development procedures used in the evaluation of the Coosa River Navigation Project, the case study example for illustrating the capabilities of MRMI.

TRAINING COURSE SESSION I

2.1 Introduction to the Multiregional Multi-Industry (MRMI) Forecasting Model
(User Manual, Sections 2.1, 2.2)

A brief introduction to the theory behind MRMI is presented. This is followed by a general outline of the model itself. Emphasis is placed upon the major blocks of the model and their relationship to other blocks. This part of the session also describes the economic and demographic detail embodied in MRMI and data sources used to estimate model coefficients. The relationship of MRMI forecasts to macroeconomic and national inter-industry forecasts is also discussed, leading to an outline of how these latter forecasts are sequenced with MRMI into a run procedure for generating consistent regional economic projections.

2.2 Data Development Activities for Producing Regional Forecasts
(User Manual, Section 2.3)

In this part of the training session, a conceptual outline for incorporating direct impacts into MRMI forecasts is presented. Here, the major operating principles of the model are reviewed before the methodology for incorporating direct impacts into the model is described.

2.3 Major Input Requirements of MRMI
(User Manual, Section 3.1, 3.3)

This part of the training session describes the input data requirements for producing baseline and impact regional forecasts. Two major data development activities are discussed. The first, developing macroeconomic projections to produce national controls for MRMI, considers the key series that must be projected, potential data sources for these projections, and methodologies for forecasting macroeconomic series over planning horizons typical of Corps projects. Issues regarding the appropriateness of using a single macroeconomic forecast for both baseline and impact forecasts versus using different macroeconomic forecasts for the two scenarios are also discussed. The second, developing direct impacts data for impact scenarios, concerns the types of impact data that are most compatible with MRMI and the equations in the model which are usually perturbed in impact scenarios. Input data requirements for the construction and operational phases of waterway projects are distinguished to exhibit the fundamental differences in the way the impact forecasts are perturbed during these phases.

2.4 Consistency Considerations and the Definition of Impact Regions
(User Manual, Section 2.7, 3.4)

This part of the session will first summarize the major input requirements for producing forecasts, but in doing so, will emphasize consistency issues in developing the data. Both macroeconomic and direct impacts data are discussed in this context. The session will then be directed towards the definition of impact regions and how this affects direct impacts data requirements and resulting regional forecasts. Basic procedures for configuring the model to the impact areas under study are discussed as are procedures for allocating direct impacts data to the regional economies that make up the impact areas.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

3.3 Data Requirements for the Cross River Navigation Project (User Manual, Appendix 1)

[illegible]

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